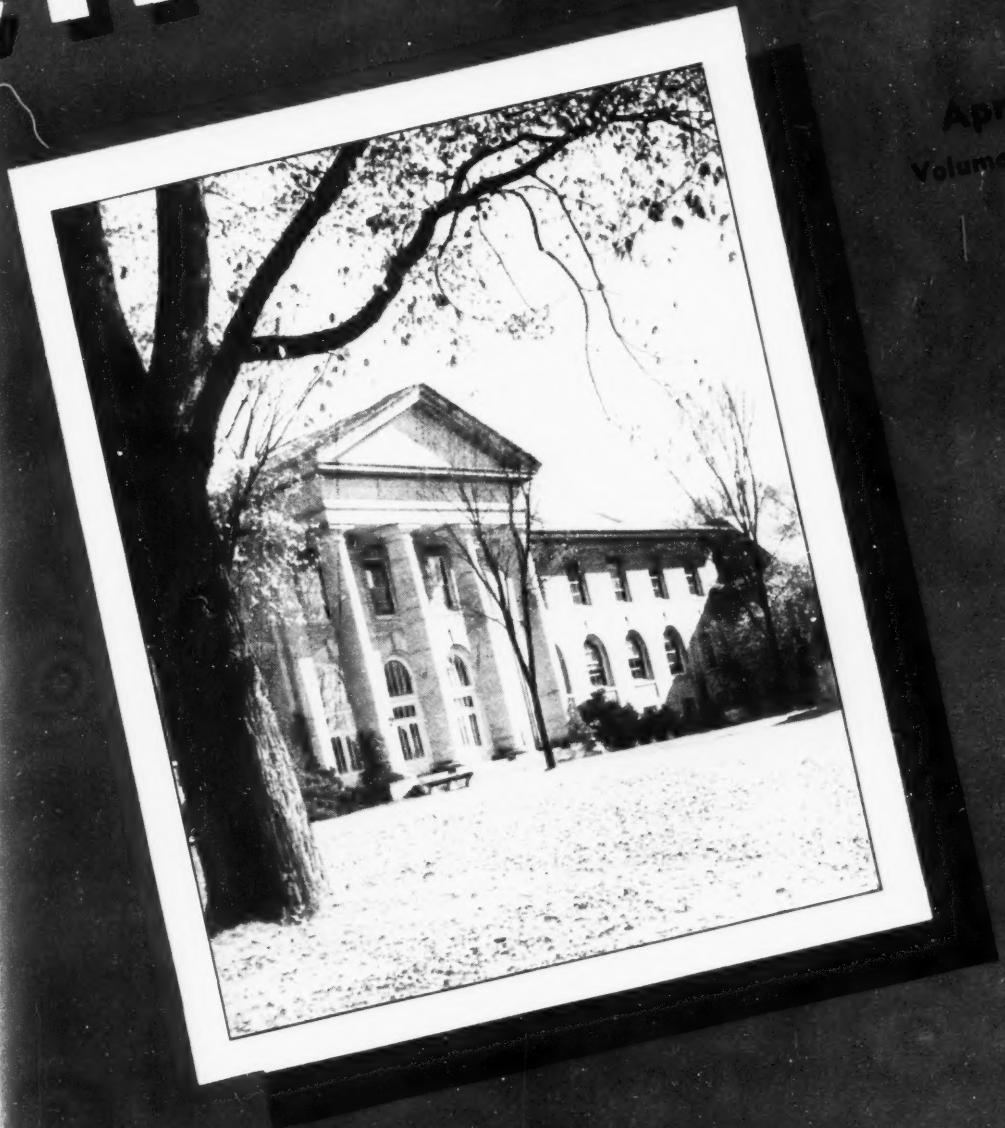
THE CORNELL ENGINEER

April, 1944
Volume 9, Number 7



COLLEGE OF ENGINEERING · CORNELL UNIVERSITY

Information supplied by an Industrial Publication

Not only the quality of steel castings, but their practicability and production cost under ordinary foundry conditions are influenced by design. The following suggestions are offered as an aid to proper design.

1. Whenever possible, all sections should be designed for uniform thickness.

2. Structural design involving abrupt changes in section should be avoided.

3. Sharp corners at adjoining sections should be eliminated whenever possible.

4. When the structure becomes very complicated, it is better to break it into several components that can be cast separately and assembled by welding or bolting.

5. In designing unfed sections in "L" or "V" shapes, it is suggested that all sharp corners at the junction be replaced by radii so that this section becomes slightly smaller than that of the arms.

6. In designing sections that join to make an "X", it is suggested that two of the arms be offset considerably.

7. In the case of unfed "T" and "X" sections, the radii at the junctions should be relatively small.

Founded 1885

The CORNELL ENGINEER

Volume 9 APRIL 1944 Number 7

Contents

Published monthly—October to May—by the **Cornell Engineer, Inc.**, Lincoln Hall,, Ithaca, N. Y. Edited by the undergraduates of the College of Engineering, Cornell University. Entered as second class matter at the Post Office at Ithaca, N. Y., under Section 103, Act of October 3, 1917.

The **Sibley Journal of Engineering** was founded in 1885, the **Cornell Civil Engineer** in 1891. The two were consolidated in 1935 into the **Cornell Engineer.**

Subscription per year: regular $1.50; with membership in the Cornell Society of Engineers $2.00 (See President's page); student $1.00; single copy $.20.

Six-Way Directional Microphone

By W. R. HARRY, E.E. '36

Transmission Instrument Development, Bell Telephone Laboratories, Inc.

THE next time you find yourself at a cocktail party completely absorbed in one person's conversation and oblivious to the chatter around you, don't give all the credit to her charm and wit. Just put a finger in one ear and see how much harder it is to follow her 'line"; then take the finger out and see how your binaural hearing enables you to disregard unwanted sounds.

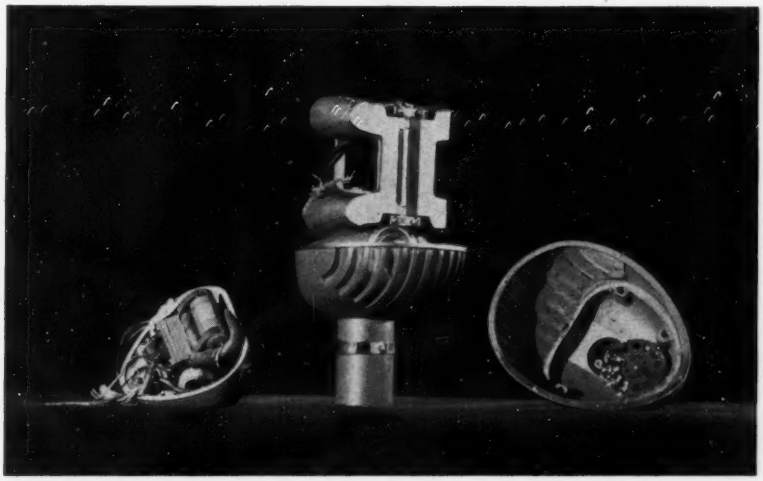
The microphone of a broadcast pick-up or a sound reinforcement system has the same problem—how to discriminate against audience noise or reflections from walls or ceiling. At the present time the only known ways of eliminating these sounds, provided they cannot be eliminated at their source, are either to place the microphone very close to the performer or to provide directivity in the microphone so that its sensitive side may be turned toward the performers and away from the disturbing noises.

A successful approach to the problem of directivity has taken advantage of the characteristics of the moving-coil and the ribbon microphones. The former picks up vibrations from the face of the diaphragm only, and thus is sensitive to sounds from all directions. Both faces of the ribbon are exposed to sound, and therefore its electrical ouput is proportional to the cosine of the angle of approach, when that is measured from a line perpendicular to the plane of the ribbon. When the outputs of the two elements are combined, sounds arriving from the front produce currents which are in phase and therefore add, while sounds arriving from the rear produce currents which are in phase opposition and tend to cancel each other.

Operation of this combination gives the equation $E=a + b \cos X$ for the output voltage, where a is the output of the moving coil element, which is independent of the angle, and $b \cos X$ that of the ribbon element for sound approaching at an angle X to a line drawn perpendicular to the plane of the ribbon. This is the equation of a family of polar curves which change with the values assigned to a and b. Actually the directional characteristics are represented by surfaces of revoltion in three-dimensional space.

For many applications the most useful characteristics are obtained when a is equal to or less than b that is, when the pressure element (moving coil) output is less than that of the pressure gradient (ribbon) element. Where $a = b$ the two elements are equal; and they are out of phase for sound incident at 180 degrees; so that concellation occurs at this angle. This gives the cardioid pattern of the Western Electric 639A microphone. Where the value of a is decreased the two angles symmetrically disposed around 180 degrees so that cancellation results at these two angles. By adjusting the output of the pressure elements with respect to the pressure gradient element the zones of minimum sensitivity may be shifted to any point between 90 and 180 degrees; this feature is used in the six-way directional microphone known as the 639B. Three definite patterns were chosen because an arrangement for continuously varying the combination would introduce serious contact and noise problems in

Interview View of Directional Microphone
Bell Telephone Laboratory

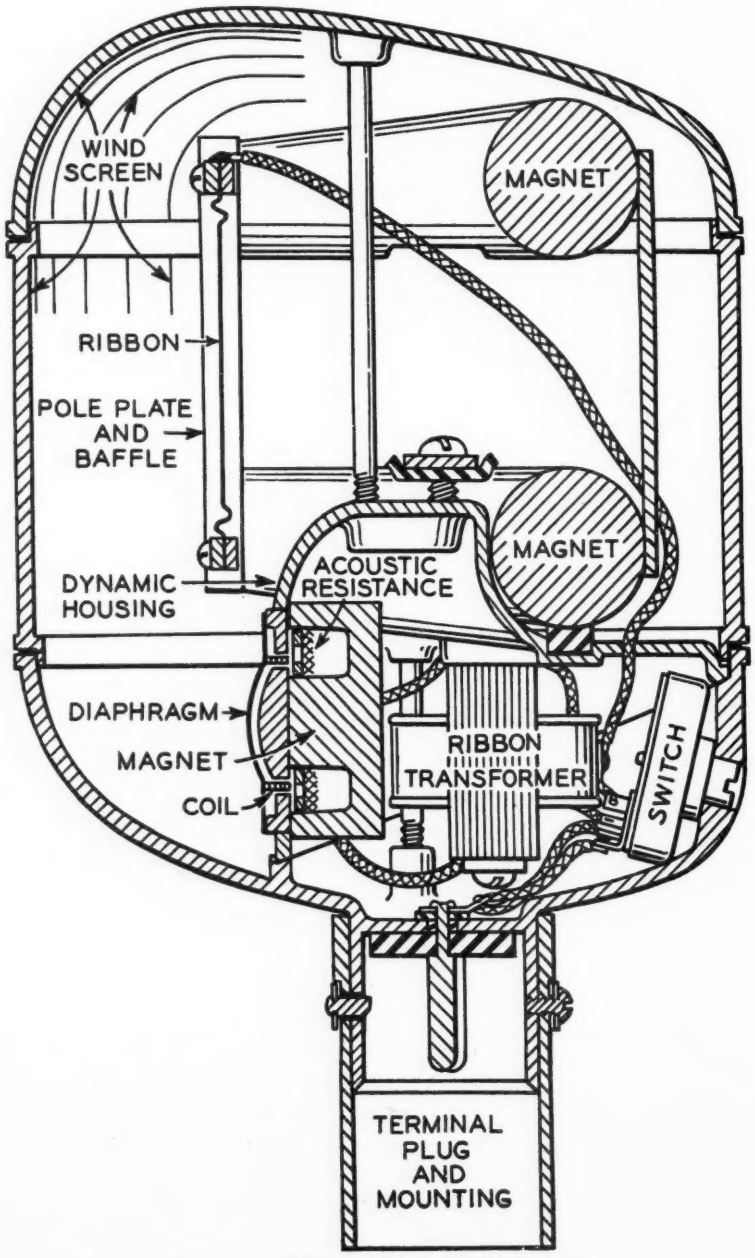


THE AUTHOR

W. R. Harry graduated from Cornell University in 1936 with the degree of E.E. in Communications, and joined the Technical Staff of the Bell Laboratories in the fall of 1936. His first work was product engineering on microphones used for radio and sound pictures. Following this he did much of the development work on the 639A cardioid directional microphone and on the more recent 639B six-way directional microphone.

the low-level microphone circuit, whereas fixed switch positions provide reliable operation and sufficient choice of pattern for all practical purposes. Provision has been made for reducing the output of the pressure element so that all of the directional patterns may be obtained. This is a ccomplished by connecting different values of shunt resistance across the pressure element without breaking the main microphone circuit. A six-position switch permits the selection of either the moving coil or the ribbon elements, the cardioid combination and the three new directional patterns.

Shunting the output of the moving-coil element to reduce its output is all that would be necessary to obtain the new directional patterns in an ideal theoretical microphone, but the problem is more complicated in practice. Phase equalization is largely responsible for the excellent agreement of the cardioid directional characteristics with the theoretical cardioid over a wide range of frequencies. This equalization was used partly to compensate phase differences arising within the elements themselves and also to correct the phase difference caused by the different distance which sound had to travel to reach the two elements. The selection of new angles of minimum sensitivity changes the amount of this correction and the constants of the phase-corrective network were therefore changed accordingly.



Cross-sectional View of Directional Microphone

Limits of Systems

Limits of voice-reinforcement with public address systems are usually encountered at a volume just below that at which the overall system begins to sing. When that occurs, the acoustic loss over some path from a loudspeaker to the microphone is equal to the gain in the electrical system. Singing may be prevented by increasing the loss over that path; the end may be achieved by pointing a "blind spot" of the microphone in that direction. For instance, an experimental 639B microphone was used in the public-address installation when Anthony Eden, British War Secretary, talked at the Waldorf-Astoria Hotel in New York, December 9, 1938. A 2-db increase was permitted in the sound output over that obtainable with the cardioid pattern before singing occurred. Although the cardioid gave quite satisfactory service in this location, the additional improvement obtained in this trial encouraged extensive probing into the action of these pick-up patterns under other conditions encountered in the field.

A sound-reinforcement system was installed in the U. S. House of Representatives in January, 1939. The highly reflecting marble walls and the shape of the auditorium made feedback conditions so severe that serviceable reinforcement was difficult to obtain without developing "sing". To relieve this situation, a 639B was employed.

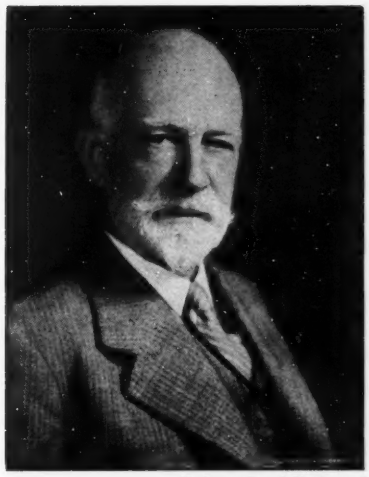
At the huge Madison Square Garden, indoor sports arena in New York, the sound-reinforcement problem is difficult because the loud speakers are arranged so as to radiate sound equally in all directions

(Continued on page 32)

Dr. William Frederick Durand Dean of American Engineering

By FRANK O. ELLENWOOD

John Edson Sweet Professor of Engineering



Underwood and Underwood
Dr. Durand

DR. William Frederick Durand, distinguished scientist, engineer, former professor and acting director of Sibley College, was the guest of honor at a dinner given at the Hotel Statler, in Washington, D.C., Mar. 4, the evening preceding the eighty-fifth anniversary of his birth. This occasion was marked by the presentation to him of the newly published "W. F. Durand Anniversary Volume" of papers selected from more than two hundred that he has already presented before societies in the field of aeronautics, mechanical engineering, naval architecture, and marine engineering. The foreword to this anniversary volume, written by Dr. Frank B. Jewett, president of the National Academy of Sciences, summarizes so many of Dr. Durand's outstanding characteristics that I cannot do better than extract some parts of this appreciation:

"Few, if any, men in the United States command greater respect and admiration of scientists and engineers than William Frederick Durand. None command greater love or loyalty from those who know him whether they be within or without the field of science and engineering.

"At eighty-five he is the unquestioned dean of the engineering profession. Time, aided by his lifelong temperate ways of life, has dealt kindly with him. While nature has not spared him entirely so far as his powers of physical endurance are concerned, it has been extraordinarily lenient and has taken no toll of his remarkable mental faculties, his youthful enthusiasms, or of his qualities of impartial judical judgment.

"Clearly he was born with certain attributes of body and mind which cannot be acquired later although they may be destroyed. With a body inherently strong was associated the embryo of an imaginative mind of great analytical capacity, calm tolerance and the driving power of a will to work. The one he has never abused unless incessant productive labor is an abuse; the other he has exercised and developed continuously through the years of an extraordinary active life.

"Innately a gentle man and a gentlemen in everything that that compound word implies, he has an acutely sensitive regard for the feelings of others. No element of malice is a part of his being nor is he ever guilty of saying or doing even inadvertently those things which wound the sensibilities of others. To this fundamental base he has added through long years of experience a knowledge of just what to do and when and how, to the end that differences of opinion are reconciled and conflicts minimized or avoided. In any joint

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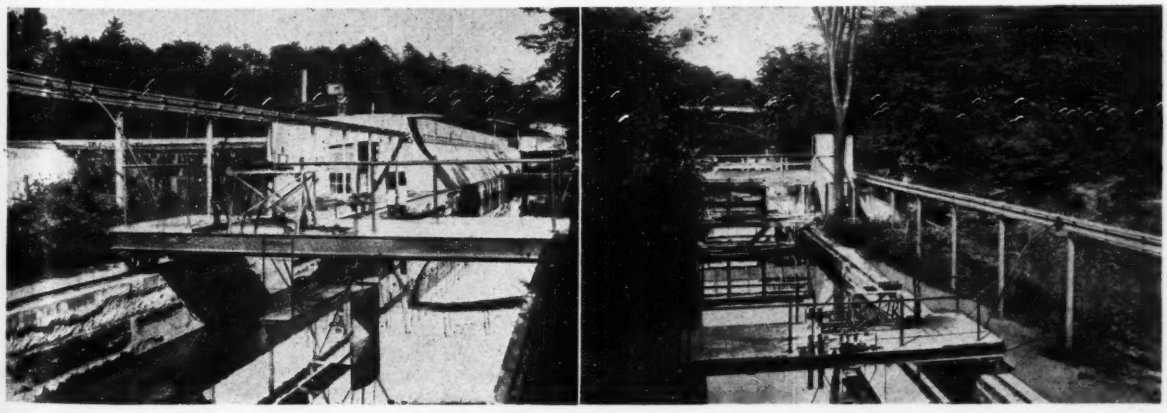
The Cornell University Experimental Canal as it appeared in 1902.



Engineering In Syria

By MICHAEL A. SAAD

Assistant in Civil Engineering

GEOGRAPHICALLY speaking, the boundaries of Syria extend from Turkey in the North to the Suez Canal in the South, and from the Euphrates in the East to the Mediterranean in the West. In the Treaty of Versailles, Syria was divided into four separate parts, Palestine, Transjordan, Lebanon and the present independent state of Syria. Palestine and Transjordan were entrusted to the British while Lebanon and the present state of Syria were put under French mandate, Class A, which meant training for independence that will be granted at the end of a twenty-five year period of political "education" on self-government.

Lebanon is the coastal sector that lies between Turkey and Palestine and extends about forty miles inland towards the East. This small strip of land is the nucleus of modern education in the Middle East. Beirut, capital of Lebanon, is a cosmopolitan center and a focal point of Eastern and Western culture. The two outstanding universities in this city are the American University of Beirut and the Jesuites, a French university.

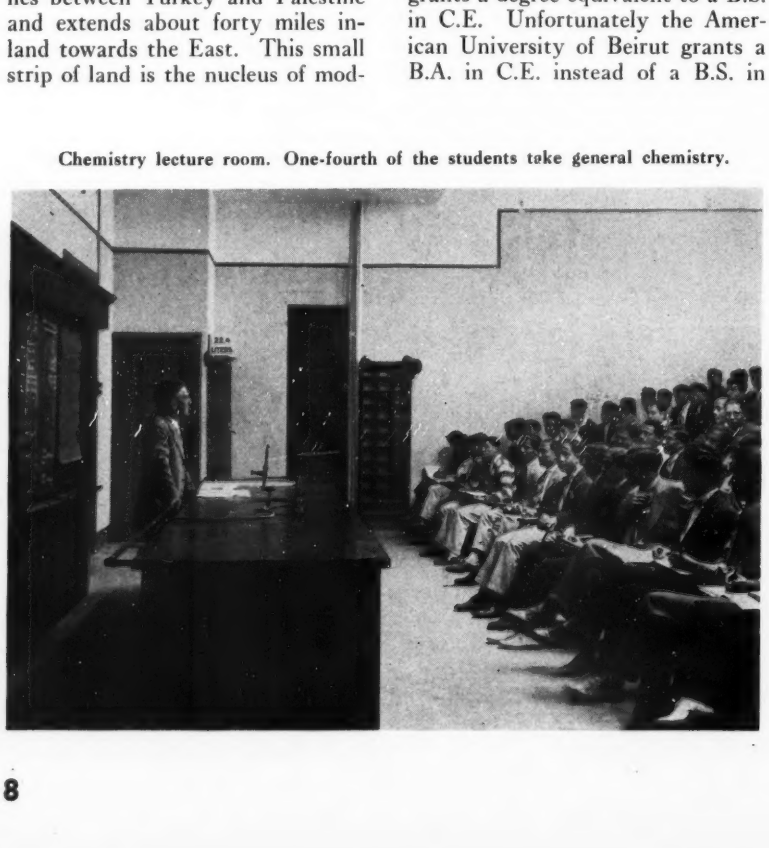
Two Schools of Thought

Engineering in Syria (hereafter when Syria is mentioned, it refers to both Lebanon and the present state of Syria) is divided into two schools of thought—the Latin and the Anglo-Saxon. The first of these two categories refers to those who graduate from French institutions and the second, to graduates from British and American institutions. The Jesuites' School of Engineering grants a degree equivalent to a B.S. in C.E. Unfortunately the American University of Beirut grants a B.A. in C.E. instead of a B.S. in C.E. because of the lack of laboratory facilities. As a result, Engineering graduates from the American University have to complete their course of study either in England or in this country. In spite of this handicap, financially and otherwise, there is quite a demand on the engineering course offered by the American University.

The chances of government employment are very much in favor of the Jesuites' graduates. This is not strange since the country is under French control. Authorities prefer the French educated fellows because, together with their professional career, they have been exposed to the political "education" vital to the very life of the promised independence.

From an economic standpoint, the tuition fees in the British schools, as well as in the American

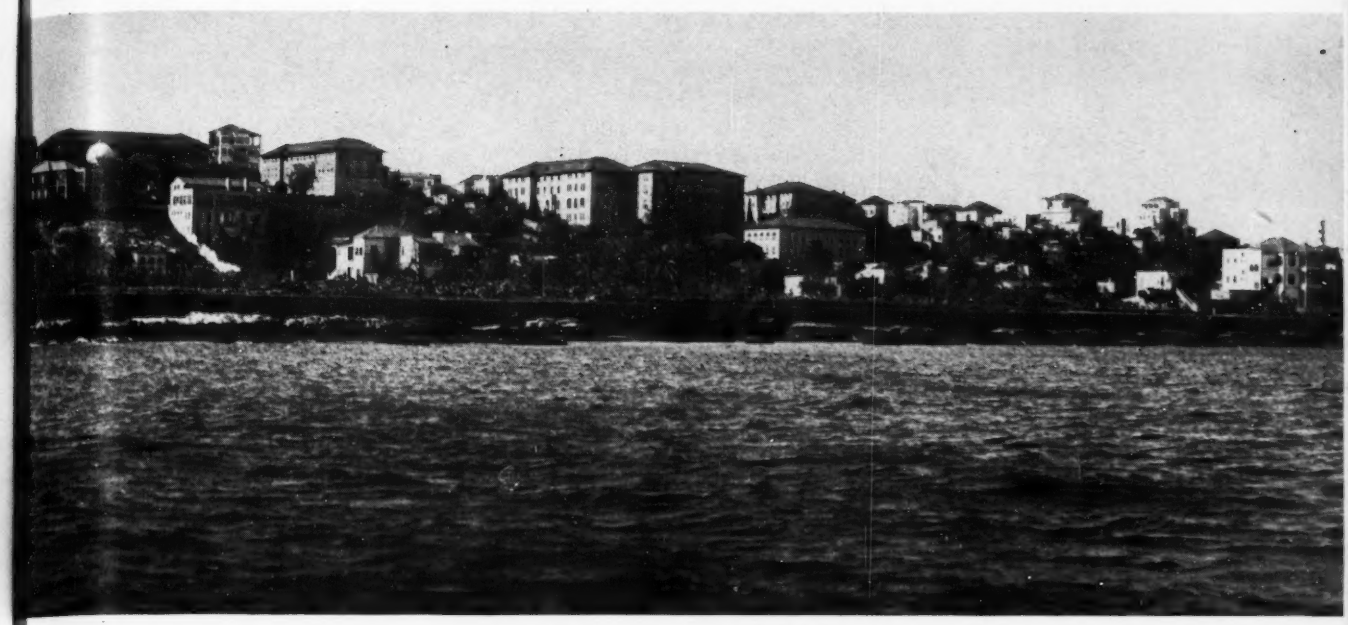
Chemistry lecture room. One-fourth of the students take general chemistry.



THE AUTHOR

Michael A. Saad was born in Lebanon, Syria in 1917. After attending the British Machinery School, he entered the American University at Beirut. In 1938, he was awarded the degree of BS in CE. While an undergraduate Saad was active in the Engineering Society of the American University. After spending a year on the administrative staff, he came to the University of Texas where he received the degree of BS in CE and MCE. At Texas, Saad was President of the International Relations Club and Chairman of the International House Center Committee.

At present he is an instructor in Civil Engineering here at Cornell.



Panoramic View of The American University

University of Beirut, are practically three times greater than those of the French schools. Students enrolled in British and American schools are faced with a great deal of hardships of future government employment. Although this is true and very clear in the minds of the people, the demand on Anglo-Saxon education is as great as that on the Latin. The one and only reason for this tendency toward Anglo-Saxon education is that the people in the Middle East have come to believe more in a free and liberally education than in an education based on religious myths and political aims. This propensity started at the end of the last World War and gained momentum in the thirties when the French mandatory policy proved to be a complete failure.

Engineer Is Architect

The term engineer in Syria includes the architect, but is usually ascribed to a civil engineer. Electrical, mechanical, chemical, and other engineers are very few in number and their various fields of work are very limited. This picture in all probability will change in the future as the agriculture and industry of the country develop beyond their pre-war status. Recent events pertaining to the oil discoveries in Iran and Saudi Arabia are strong indications in favor of this viewpoint, for Syria will be its Mediterranean outlet. The possibility of Syria becoming the center of aerial transportation between East and West because of its important geographic location adds greatly to this possibility.

Every engineer in Syria has charge of the design and architectural plans for any project he undertakes. As far as the contract is concerned, he is given first preference. In most cases, the engineer is the chief contractor on the job. This may appear to be too much for one man's job but so far engineers have handled the task very efficiently.

Sophomore engineers study differential leveling.

Stone and reinforced concrete are the two prevailing building materials. Steel and lumber have to be imported and their use is being avoided as much as possible on account of their high prices. Because of cheap wages and the presence of cement factories in the country, economy lies in the use of stone and concrete as the two chief building materials whenever it is practicable. Nevertheless, whenever possible, stone is substituted for concrete and in cases where concrete is used, the design is based on the minimum permissible percentage of reinforcement. As an example, ninety-eight per cent of the bridges are built with limestone and the same applies to commercial and residential buildings, except in those places where stone quarries are not within reach.

Double-wall Stone Masonary

Double-wall stone masonry for residential buildings was the practice in the past. This was believed to give a high factor of safety and better protection against humidity. In more recent years, the single wall stone masonry with an average thickness of 8″ to 10″ has become prevalent since it serves both purposes. As a matter of fact, it was shown that singlewall stone masonry can stand more arching effect than a double wall.

Cement plaster is predominately used for the inside finish of walls in residential buildings. A few attempts were made to use wallpaper, but the public did not react favorably to it. Invariably, floors are covered with cement tiles of various de-

(Continued on page 26)

Silent Sound In Action

By HOWARD J. SAMUELY, ChemE '46

TO the average human ear, the lowest audible sounds are the deep tones of an organ, in the region of sixteen vibrations a second. From this bottom threshold of human audition upward, the range progresses through the bawling of a newborn baby at 435 cycles, the shrillest outpouring of an operatic soprano at 768 cycles, the highest note on a piccolo at 4,752 cycles, and the cry of a newly hatched robin or the jingling of keys at 15,000 cycles. By this time, most people have reached the ceiling of audibility. But beyond this lies a vast spectrum of sound to which our ears give no response. These ghost vibrations beyond 15,000 cycles are termed supersonics. Cycles greater than 40,000 a second are classed as ultrasonics, which range as high as 5,000,000 cycles a second. Although inaudible to man, these high-frequency sound waves are heard by animals, particularly dogs and bats. It has been demonstrated, for instance, that bats are capable of flying blind largely through the mechanism of emitting high-frequency screaches and detecting their echoes as they rebound from objects along their path. For man, this has become the underlying principle of a widely employed system of submarine detection. Unlike radio waves, which are transverse and electromagnetic in nature, these ultrasonic waves, like ordinary sound vibrations, are longitudinal, inducing compressions and rarefactions in the medium through which they pass. While radio waves may be transmitted through a vacuum, this is quite impossible with ultrasonics. This distinction provides no hindrance, however, to the widespread and diverse application of ultrasonics in industry.

Galton's Whistle

In 1883, Galton's whistle became the first deliberate attempt at human propagation of supersonics. The whistle consisted of a nozzle in the shape of a cylindrical slit, through which a puff of air from a rubber ball was projected. This air jet impinged upon a cylindrical cavity of adjustible depth. Galton was able to generate frequencies as high as 25,000 vibrations per second. Subsequently, frequencies up to 90,000 were produced with tiny tuning forks a few millimeters in length. The determination of the actual frequency emitted was made with a Kundt tube, in which were formed wave patterns in lycopodium or cork dust. By 1900, an improved Galton whistle appeared, emitting frequencies in the neighborhood of 110,000 vibrations a second.

In later years, ultrasonic waves were obtained from the oscillatory spark discharges of condensers. Although the flash of a discharging condenser, to the casual observer, is nothing more than a single impulse, it is, in fact, a speedy succession of sparks capable of producing an ultrasonic wave train with frequencies greater than 300,000 vibrations a second. Furthermore, high-frequency sound waves may be generated by a rod or tube of ferromagnetic material, which will contract and expand when exposed to a varying magnetic field. Extremely high sound intensities may be emitted from the rod, usually of nickel, if the natural frequency of the rod and the frequency of the field are made to coincide either by adjusting the length of the rod or the oscillations of the magnetic field.

In 1880, Jacques and Pierre Curie discovered that particular crystals alter their size when placed in an electric field. Moreover, when these same crystals are subjected to pressure, they develop concentrations of electric charge on their opposite faces. For instance, if an appropriately cut crystal of Rochelle salt, to which metal electrodes are attached on opposite faces, is tapped only slightly, sufficient current is released to discharge a small neon lamp. Useful in radio especially, this piezo-electricity may also be employed in the emission of high-frequency sound. A flat plate cut from a crystal of quartz is coated with metal to provide electrode contact. Under the action of a high-frequency alternating current, the quartz plate expands and contracts with such rapidity that ultrasonic waves are generated, equal in frequency to the activating electrical oscillator. Conversely, when sound waves of a given frequency strike the plate, an equal frequency of alternating current is induced. In this fashion, the crystal constitutes both a transmitter and a receiver of high-frequency sound impulses. If the source of the alternating cur-

rent, usually a vacuum tube, has its frequency tuned to the mechanical frequency of the quartz plate, resonance is obtained, and the vibrations may reach enormous frequencies. A beam of ultrasonic waves produced by a mosaic of such plates vibrating in unison between electrodes made of steel discs may propagate sound up to 500,000 cycles per second, capable of traveling under water for miles.

The use of high-frequency sound has the special advantage that the waves may conveniently be adjusted to a fine pencil of rays with directional characteristics determinable to one degree of accuracy. In addition, ultrasonic waves may be radiated at high intensities without creating excessive amplitudes in the source, which might otherwise introduce severe strains in the acoustic vibrator. Since ultrasonic waves are much too readily dissipated in air, their practical use has largely been limited to under-water conditions.

Marine Applications

In 1912, two patents were granted for ultrasonic transmitters to be employed for indicating the presence of icebergs. Ultrasonics has found application in ship-to-ship communication also. The transmitter, having a range of from six to nine miles, is attached to the hull of the vessel. The signalling is done by Morse code or by telephony, and the ultrasonic waves released by the quartz vibrators are modulated by speech frequencies. During the last war, these transmitters were utilized to detect the approach of submarines. Even more recently, the Navy has proposed the use of ultrasonics to explode mines and torpedoes from a distance.

In detection work, the ultrasonic signals are emitted at short intervals, between which the transmitter is switched over to a receiver, which will register the returning sound impulses. The time taken for the release of the wave and its return provides an index to the distance between the submerged object and shipboard, within an accuracy of one per cent. Likewise, the depth of the sea may be recorded. Besides being silent in operation, these ultrasonic echoes achieve the added advantage of greater speed of transmission—as fast as fifteen soundings a second. With ultrasonics, soundings in shallow water, otherwise difficult, may be obtained to a high level of accuracy.

These high-frequency impulses last about a thousandth of a second, energized by a peak voltage of about 6,000 volts. The alternating voltage generated by the echo in the transmitter, which has been adjusted to reception, is relayed to a heterodyne amplifier and thence to a rotating gas-discharge lamp for the measurement of the time interval between impulses. Using these ultrasonic waves in connection with a recording device, it is an easy matter to obtain a precise profile of the sea bottom, in addition to an estimate of its nature, whether sand, mud, or clay, each having its own distinctive echo characteristic. Using ultrasonics, trawlers may more readily determine the desired depth for fishing. In addition, these multiple echoes provide a clue to the presence of shoals of fish or other marine life, of interest also to the deep-sea explorer.

The modulation of ultrasonic waves in liquids is the basis of the Scophony system of television. Illumination in television techniques other than those employing a cathode-ray tube is inversely proportional to the number of elements in the picture. Any increase in definition is obtained at the expense of reduced illumination. This difficulty is partially overcome by the Scophony system, which, by using ultrasonic waves, gives a screen illumination inversely proportional only to the square root of the definition.

Emulsions Stabilized

It has been established that the homogeniety and stability of photographic emulsions are enhanced by these high-frequency vibrations. The silver halide concentration increases markedly with the attendant rise in resolving power and sensitivity of the film. Detrimental agglomeration of the grains in the photographic film is not only prevented by ultrasonics, but when already present may be altogether eliminated. The strong dispersive action of ultrasonics increases the color sensitivity of the emulsion by causing a far greater utilization of the added dyes by the halide grains. An avoidance of the tedious opera-

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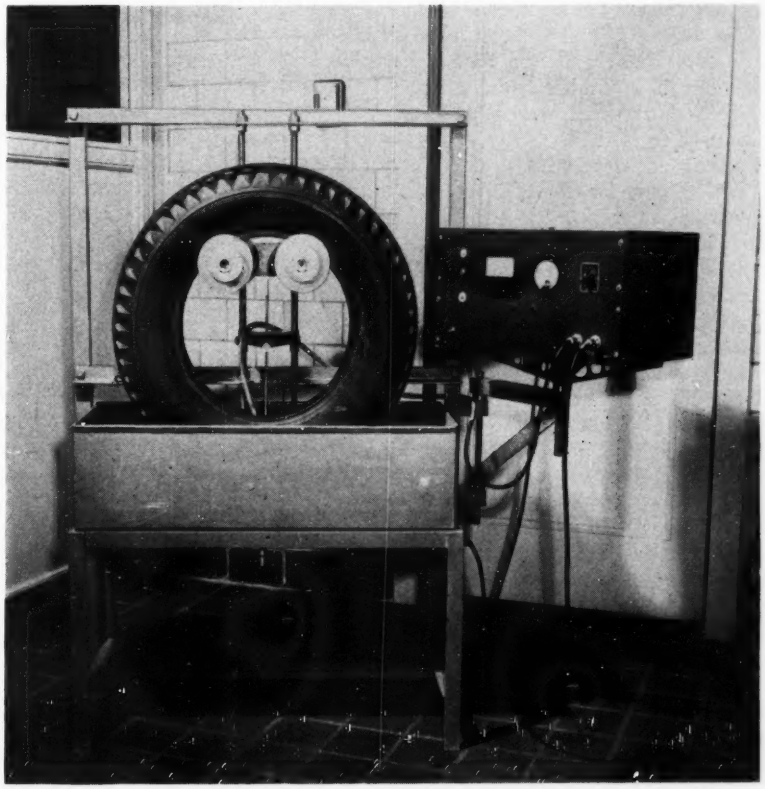


Courtesy Goodyear

The inspection of rubber tires is made possible with ultrasonic waves.

Mrs. Rea

Mrs. Frances K. Rea

V-12 boys in the ME school who enter Professor Hanselman's office to have their programs changed are greeted nowadays by the pleasant smile of his new secretarial assistant, Mrs. Frances K. Rea. Although she has been in her present post only a short time, Mrs. Rea is no stranger to Cornell. She had been working in the AEME office in West Sibley for more than nine years.

Mrs. Rea was born in Ithaca and has lived here all her life. She is known to many Ithacans by her maiden name, Frances Klinko. The fact that she has never been elsewhere does not distress her in the least. "I like it here," she explains, "and I don't ever want to go anywhere else." During the time she attended Ithaca High School, Mrs. Rea worked afternoons. Still she found enough free time to join a singing group and also the Girl Scouts. Later she gave up both organizations, but not before she had earned more than twenty merit badges as a Girl Scout.

The service star which Mrs. Rea now wears on her lapel is for her husband in the Seabees. Mr. Rea (now Petty Officer, 2nd class) is an Ithacan but not a Cornellian. He joined the Navy in April, 1943, and has been overseas for several months. Mrs. Rea's favorite pastime is receiving letters from her husband, and she spends much of her free time writing to him. They have been married four years.

The warm smile which can always be associated with Mrs. Rea is indicative of her nature. She is easy to get along with since she has very few dislikes or prejudices. Mrs. Rea is extremely interested in her work; she considers it a hobby as well as a profession. She is very fond of the students and co-workers she comes in contact with, and is pleased when she can help them out. It is quite hard to satisfy the V-12 boys who want their programs changed, she says, but she tries her best to do so.

Last summer Mrs. Rea broke into print when the CORNELL ENGINEER found her pitching pennies outside of Sibley with other members of the "Sibley Health Thorugh Penny Pitching Society." "I didn't do so badly," she reflects, "but Professor Hanselman really cleaned up."

Of the more conventional forms of relaxation and entertainment Mrs. Rea likes crossword puzzles, the radio, and the movies. Among her favorites in entertainment are radio comedians and screen musicals. She is not fond of war pictures or radio "soap operas," and she is by no means a Frank Sinatra enthusiast.

Mrs. Dorothy Hendrickson

MRS. Robert Hendrickson, secretary to W. L. Malcolm, Director of the School of Civil Engineering, was born in Burlington, Vermont, and her parents, Mr. and Mrs. Quimette, gave their little girl the name of Dorothy. Burlington is a small city of about 25,000, and it was there that Dorothy went to high school and grew up. It was shortly after finishing a post-graduate course at Burlington High that Dorothy married Mr. Robert Hendrickson, a radio announcer for station WCAX in Burlington. While working in a hardware store as a secretary, she met a woman who came into the store occasionally. When she discovered that this lady was in need of a secretary, she took an interview, got the job, and left the humdrum hardware store to become employed by Lady Grenfell. After some time, Mrs. Hendrickson had to leave her position. Soon after an addition was made to the Hendickson family in the person of young Leif, better known as "Sookie".

Meanwhile station WCAX had become a C.B.S. affiliate and was expanding. Mrs. Hendrickson was intrigued by the novelty that was offered by the field of radio and accepted a position of receptionist and secretary, which was to turn into a job for a Jack-of-all-trades. First, the program director was drafted; then, the announcer that took his place died. This was when Mrs. Hendrickson became program director for WCAX, besides handling all C.B.S. traffic. It was interesting work, but the hours were long and the job a full one—too full.

About this time, Mr. Hendrickson and his wife and little boy came to Ithaca to visit Mr. Hendrickson's people, and it was here that they met Mike Hanna of WHCU. Radio people get acquainted quickly, and Mike said that if he had an opening he would certainly like to hire Dorothy with her experience in radio. He suggested that she get a job at the University. So amid the protests of WCAX, in which she had become an important part, she and "Sookie" moved to Ithaca. On the aptitude test which is required of all applicants for jobs in the University, she made an exception-

Mrs. Hendrickson

SECRETARIES

ally high grade, following which she accepted the position as secretary to Director Malcolm.

Now, Mr. Hendrickson is in the Signal Corps, and "Sookie" is in the Fall Creek Grammar School. When the war is over, the Hendricksons want to make Ithaca their home. Mrs. Hendrickson says that she is out of radio for good now, because the work in the C.E. office is much more suited to her. Besides, she likes it better. The members of the C.E. school are mighty glad she does like it better, for they would certainly miss her if she were to leave.

Miss Katharine Handlen

ALTHOUGH built up as a terror by one of the instructors in the E.E. school, Katherine Handlen hardly looks or plays the part.

Born and raised in Ithaca, Miss Handlen received her education here. After finishing business school, she came to Cornell as a stenographer in the E.E. Department of the Mechanical Engineering School. At that time, there was only one secretary for the entire college. When the E.E. Department became a school in its own right, Miss Handlen's title changed to secretary although her duties remained the same.

An old timer in the College, she knows many men who have achieved fame in engineering after leaving Cornell. Miss Handlen has always had pleasant relations with the faculty of the school. After some deliberation, she decided that Professor Gray was the most human, interesting, and friendly person she met in her time at Cornell. "His home was always open to everyone," she reminisced. However, she has found no lack of interesting or friendly people since that time. At the present time, Miss Handlen, along with most everyone else, is wondering when the new E.E. Director will come.

Miss Handlen

Miss Handlen is a thoroughly indoctrinated E.E. She is convinced that the E.E. School is best, and the technical language of the men in it is no puzzle to her. The advent of V-12 has increased her work many times over what it had been previously. However, the addition of an assistant to the staff has been a boon.

Through the years, Miss Handlen has maintained her high spirit and thoroughly enjoys her work and the students she meets. She is most happy to stay with her work in Franklin and watch the E.E.'s go by.

Miss Lucy Broadhead

THE year, 1942, brought two gifts to Cornell's School of Chemical Engineering—Miss Lucy Broadhead and Olin Hall. It all came about when Lucy, a young secretary who had been working a year and a half for one of the professors in the Poultry Department of the Cornell Agricultural College, happened to hear about a new building taking shape on the corner of Campus Road and Central Avenue. Lucy decided to inspect the grounds for herself. In so doing, she met Dr. Fred Hofmann Rhodes, Director of the School of Chemical Engineering. On the spot, Dr. Rhodes offered her the position of secretary, which Lucy hastened to accept. For the rest of the narrative, it need only be said that the Chemical Engineering School gained not only a competent co-worker but one of its particularly good friends.

Miss Broadhead

Lucy was born in Jamestown at the western tip of New York State, where she attended grade school and high school. Part time, she did secretarial work in a local worsted mill managed by her father. Lucy smiled as she recalled delightful experiences sailing, swimming, and fishing on nearby Chautauqua Lake, where the Broadheads kept a summer cottage.

Upon graduation from high school, Lucy attended the Katharine Gibbs Secretarial School in Boston. Shortly thereafter, she obtained a position in Buffalo, working for two engineers simultaneously. One was a sales engineer for the Duriron Company, the other for the Mason-Neilan Regulator Company. In theory at least, one of the engineers was supposed to be out of town on business while the other had the use of her secretarial services. But more often than not, both of her employers were in Buffalo concurrently. A year and a half of this hectic routine was enough. And Lucy came to Cornell.

Lucy carries a substantial part of the secretarial responsibilities in Olin Hall. This means not only the standard jobs that come to mind immediately but, in addition, those one hundred and one unclassified tasks that must be performed with precision if the Chemical Engineering School is to be run at top efficiency. Another particularly essential assignment is that of making

(Continued on page 28)

NEWS OF THE COLLEGE

Atmos

THE members of Atmos met March 10, 1944 to elect officers and new members. The offices were filled as follows:

President, Alexander Beebee
Vice-pres., Frank Swingle
Sec'y.-Treas., William Parker

The fifteen new members elected are:

George Ford
George Swanson
Stanley Noss
James Deyo
William Pearson
William Richardson
Sanford Whittwell
William Menges
Roy Hughes
Robert Preston
Eugene Wolfe
Norm Dawson
Jack Schuyler
Ed Rourke
John Krueter

These men were initiated March 24 at Willard Straight, and a cocktail party was held in their honor the following afternoon at the new Sigma Alpha Epsilon house on Stewart Avenue. Faculty members were present.

ASME

MEMBERS of the Cornell Student Branch of the ASME and their friends met in Room 2 of West Sibley at 7:30 on March 21, 1944, for a short meeting and movies. Alexander Beebee, Chairman, led the meeting during which future meetings, a party, several oratorical prizes, and a student loan fund were discussed.

Mr. Walter Koch explained the content of the two pictures. "PBY Record Breakers" showed the steps in construction of the Catalina Flying Boat in the Consolidated plant at San Diego. Testing of oil tanks for water tightness, testing of structural parts, inspection of welded and cast parts for flaws by the magnaflux method were included.

The other movie, "Fairchild PT 19 Trainer", was in technicolor and depicted the conception and construction of the plane by Fairchild. Its feature points were pointed out, i.e. it resembles a combat plane and enables students to get the "feel" of such a ship; it is built for maximum safety with a wide wheel separation and minimum stall of the wings.

Fairchild "Cornell" Trainer

On April 3 a movie on the Sikorsky Helicopter was shown.

AIEE

AT a meeting held on Thursday, February 24, Professor True McLean gave an illustrated lecture on "High Fidelity Recording." The illustrations consisted of projected photographs which were taken by Professor McLean. Photomicrography, coupled with such special tricks as precipitation of solid "smoke" particles on the record surface and use of angled lighting, resulted in pictures which clearly brought out the main point of the talk.

Dealing only with the "needle on surface" type of recording, Professor McLean described the advance of sound recording from the Gramophone using cylindrical records, through the English-originated recorder using the disk type of record, up to the modern high fidelity, electrical pick-up recorder of today. Professor McLean reduced the complexities of maintaining high fidelity of reproduction to the more elementary problems of reducing needle wear, reducing record wear, and keeping the needle in the center of the recording groove. In conclusion, Professor McLean gave a description of the latest type of pick-up device used by radio studios; he emphasized its extreme sensitivity and expense to repair, both of which demand that the device be handled with extreme care by the broadcast technicians.

The following students are now serving as officers for the Cornell Student Branch: Robert Burr V-12, chairman; R. G. Patrick V-12, vice-chairman; N. J. Markason, secretary; Joseph Bambara V-12, treasurer.

Railroad Club

AFTER years of inactivity, the Cornell Railroad Club is being revived. With Professor Barnes acting as president, Jay L. Miller, V-12, as secretary-treasurer, and Assistant Professor Perry as Faculty Advisor, the club held its first meeting January 14, on the Willard Straight Terrace. A representative of one of the large railroads gave a talk illustrated with movies, on the present-day work of the railroads.

A second meeting was held at the end of last month. The purpose of this meeting was to discuss the

(Continued on page 34)

PUBLICATIONS

Metals and Alloys Data Book, by Samuel L. Hoyt, Reinhold Publishing Corporation, 334 pp., 1943, $4.75.

Teachers, students, and practicing engineers have long needed a source of reliable data on mechanical properties of metals—not the text books on materials or the engineers' handbooks, for these may be out of date or uncritical; nor the manufacturers' literature, for it cannot be comprehensive enough, and it may be tinged with salesmanship.

The mere statement that Dr. Hoyt has compiled such a book is inadequate. As he says in the preface, he wrote it because he needed it himself; but few metallurgists would have the background to integrate the needs of others so well. The preface, and any other textual material between the 340 tables, should certainly be read by the prospective user, for valuable advice on the use rather than the abuse of numerical data, and because it adds to the impression that here are data that have been selected both intelligently and critically. Sources are given, as are analyses, heat treatments, size limitations, and other comments.

The scope of the work cannot be properly indicated by less than the full table of contents; non-ferrous metals occupy about half as much space as ferrous ones; high and low temperature properties, endurance and impact data, corrosion resistance are valuable supplements to the usual information on the properties of quenched and tempered steels. AISI, SAE, AMS, and NE numbers and specifications are used and compared. Like most such comprehensive works, the book deserves some preliminary exploring, so the user will realize what a wide variety of information he can find in it.

In the reviewer's opinion, more of the data (such as those on hardenability and S-curves) might well have been presented in the familiar graphic form instead of in tables, without serious loss of accuracy and with some gain in convenience. It is hoped that in future editions the material on creep, corrosion, and oxidation can be extended, in line with the continually increasing need for such information and the dearth of it in other books.

C. W. Mason
Professor Chemical Microscopy and Metallography

Structural Frameworks, by C. T. Morris and S. T. Carpenter, John Wiley and Sons, New York, 1944, 272 pp., $4.00.

This book is not intended for use as a beginning text in the study of elementary steel design theory and practice. As stated in the preface, the primary purpose is to present, in usable form, analyses of some of the more complex problems which are involved in the design of buildings and other structural frames. The authors assume that the reader is familiar with the usual methods of analyses and design of simple structures, which in turn implies a working knowledge of the mechanics and strength of materials.

The first five chapters discuss briefly the loads which are involved in the design of buildings and similar structures, the common types of fireproof floor systems, the distribution of concentrated loads on concrete slabs, some of the fundamental principles in the analyses of beams, girders, and columns, and the determination of deflections of beams and trusses by the method of work (dummy unit load). These chapters consist essentially of brief "refresher" statements.

Chapter six contains a brief but carefully planned and clearly presented discussion of the analysis of rigid frames with vertical loads, by four different, but interrelated, methods: (a) integration of the elastic line, (b) area-moments, (c) slope deflection, and (d) moment distribution. Sufficient examples are given to explain the application of the various methods to the analysis of several types of one-story frames. A brief discussion of the problems involved in analyzing multistoried building frames is also included.

Chapter seven discusses wind effects on braced bents and building frames, including the allocation of the wind forces and the determination of stresses caused by these forces. It also includes a short discussion of deflections and vibrations, and a brief summary of elastic requirements. Practical examples are given to illustrate the computation of stresses and the design of typical members in building frames of moderate height by the portal method and the cantilever method. Calculations for a typical floor of a 40-story building are also included, together with the design of the lower or "transition" stories.

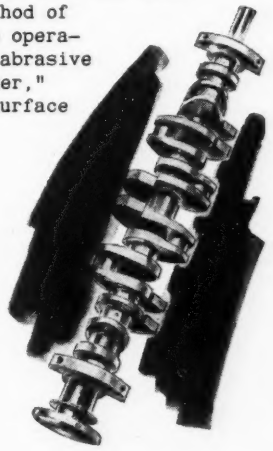
Chapter eight presents a brief treatment of the effect of asymmetry on wind-stress analysis, based on a study made by Professor George E. Large for the Committee on Wind Bracing of the American Society of Civil Engineers. Chapter nine contains a very interesting and fairly complete analysis of free-standing and guyed radio towers and high-voltage transmission line towers. Chapter ten explains the construction and the design of typical one-story industrial buildings and includes a complete design of one bay of a mill building with a flat-trussed roof and crane runway. Typical structural details for truss joints, connections of trusses to columns, column bases, and column splices are also shown and explained.

Chapter eleven presents the fundamentals of structural welding. It included a study of welds which resist only one type of stress, such as shear or tension, and welds which are subjected to combined stress effects, such as shear and bending or direct shear and torsional shear. The advantages of continuity in welded frames and the methods of obtaining such continuity are outlined with a very practical discussion of the theory of semi-rigid connected frames. The effect of fatigue in welded joints is also discussed. A complete design of a welded plate

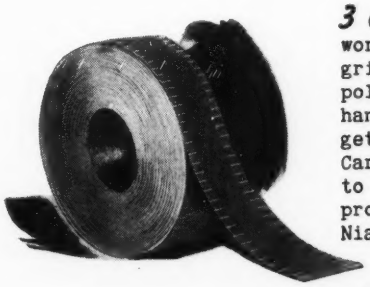
(Continued on page 32)

The darndest machine you ever saw...

1 It has an interesting, complex oscillating motion. It works up and down following crank contours. And it does it all at once! It's the darndest machine you ever saw! Yet it is one of the most efficient and productive machines of its type. Its job is to finish all of the bearing surfaces on a crankshaft at one fell swoop! The older method of performing this same operation is to hold the abrasive cloth in a "nutcracker," finishing only one surface at a time.



2 With the new machine, strips of successively finer grits of abrasive cloth, having serrated edges to permit the strips to follow the fillets of the bearings, are automatically inched past the revolving crankshaft from a feed roll of the cloth. And on many a job it's Aloxite Brand cloth by Carborundum that gives the ultimate smooth, satin finish.



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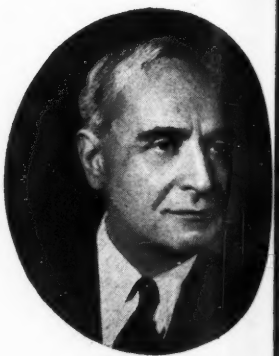
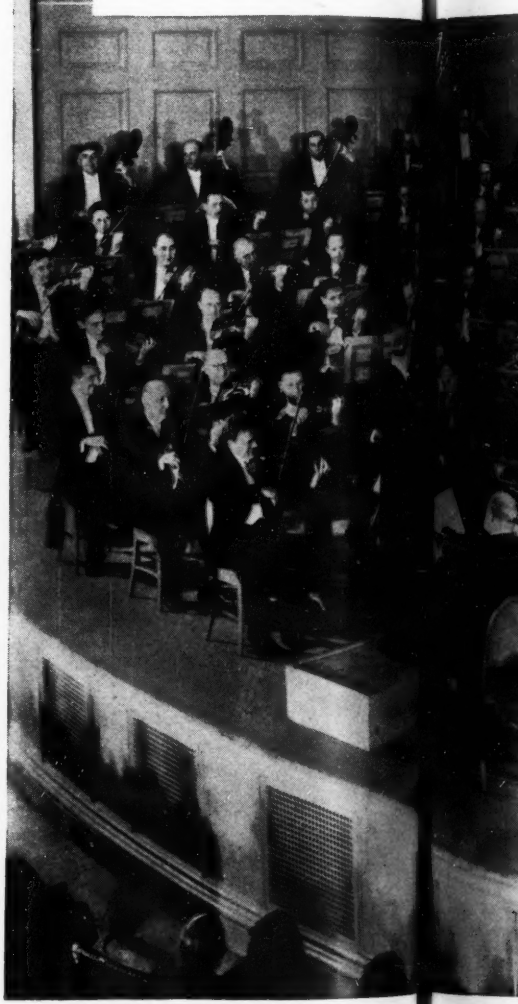


Dr. Serge Koussevitzky



ALLIS-CHALMERS AC MILWAUKEE

"ENGINEERING THAT AIDS ALL INDUSTRY—
FURTHERS AMERICAN GOOD LIVING"

Silent Sound In Action

(Continued from page 11)

tion of washing the impure silver halide and gelatine emulsion provides a considerable manufacturing advantage. Using ultrasonics, the halide is precipitated pure. Since no foreign ingredients are introduced in the emulsion base as peptizing agents to aid in the dispersion, vastly greater film durability is attained.

Hunting for Flaws

If completely homogeneous, metals exhibit exceptional transmissibility for ultrasonics. However, since inclusions, cracks, and pits impair the acoustic hardness of the metal, sound waves tend to be either locally reflected or absorbed. Here is the key to the use of ultrasonics in testing metals. By exposing the sample to high-frequency sound vibrations and determining the intensity of the sound transmitted, it is possible to pass judgment on the internal characteristics of the test piece.

The elastic constants of a transparent solid may be ascertained by passing light through the body subjected to ultrasonic radiation. The light pattern obtained is a direct function of the elasticity of the piece. In dealing with opaque solids, light reflected from a body exposed to ultrasonic waves provides a measure of the elastic characteristics of the material.

The emulsifying action of ultrasonics constitutes a significant boost to the metallurgist. A great number of alloys having total immiscibility or only nominal solubility in the liquid state may be agitated to such an extent that a very finely dispersed structure is obtained. Ordinary melts may yield more finely precipitated grains when exposed to ultrasonic radiation. The influence is one of encouraging rapid crystallization and thereby finer particle size. Mixed crystals may be obtained from alloys which normally chill to form heterogeneous grains. These high-frequency waves may also be employed to facilitate the de-magnetization of metals and to improve and hasten the nitrogen hardening of steels.

Recently the Goodyear Research Laboratories have developed a procedure for detecting the flaws in rubber tires by passing ultrasonic vibrations through water against the sides of the tire under test. As the tire is rolled through the water-filled trough, a microphone receives the waves transmitted through the rubber walls. As long as the structure remains solid, the waves pass without interruption, the amplified current serving to light a green lamp. As soon as an imperfection is encountered, the continuity of the waves is destroyed, and the light flashes red. This simple technique for testing tires may be used successfully by even the most unskilled examiner.

Insoluble Liquid Mixtures

Intense ultrasonic waves transform such otherwise insoluble liquids as water and mercury or water and benzene into emulsions stable for over twenty-four hours. Metals and alloys may be dispersed in alcohol, oil, and water to a particle-size fineness approximating half a micron. Metallic sodium has, in this way, been dispersed in organic solvents for use as a laboratory aid in determining the water content of these liquids. If a cathode is exposed to ultrasonic vibra-

(Continued on page 22)

UNION CARBIDE REPORTS

first full-year's production of

BUTADIENE

for the Government's Synthetic Rubber Program

(INSTITUTE, W. VA. PLANT)

Night view of the immense butadiene plant at Institute, W. Va.

A LITTLE OVER A YEAR AGO* the first tank car of butadiene was shipped from the Government's large integrated rubber project at Institute, W. Va. This historic shipment came from the immense butadiene plant which was designed and built by CARBIDE AND CARBON CHEMICALS CORPORATION for the Government's Defense Plant Corporation—and is being operated by this Unit of UCC, for the Rubber Reserve Company.

FIRST YEAR'S PRODUCTION OVER THE RATED CAPACITY—that is the record of this huge 80,000-ton-per-year plant during its first twelve months! This has been accomplished in spite of the many inherent problems that had to be solved in starting a wholly new project of this magnitude.

Over 8/10 of a short ton of butadiene is required to make about one long ton of Buna S type synthetic rubber. Butadiene from this plant during the past year has provided more than 90,000 long tons of synthetic rubber for the Nation's requirements, both military and essential civilian. The delivery of this all-important ingredient also has made possible early production of synthetic rubber under the Government's program.

*The first tank carload of butadiene from Institute was shipped on February 18, 1943—less than one month after Unit No. 1 of the four large butadiene-producing units had started operating. Subsequently, Unit No. 2 started producing in March, Unit No. 3 in April, and Unit No. 4 on May 25, 1943.

NOW HUGE BUTADIENE PRODUCER—although originally designed to produce 80,000 tons annual capacity, the Institute plant is now delivering butadiene at a rate of more than 100,000 tons per year. An identical plant using Carbide's process was put into operation by the Koppers United Company in September, 1943, at Kobuta, near Pittsburgh, Pa.

OVER 75% OF THE TOTAL PRODUCTION OF BUTADIENE for the Government's synthetic rubber program in 1943 came from the alcohol process developed by CARBIDE AND CARBON CHEMICALS CORPORATION.

In addition to the plant at Institute, Carbide made available plans for the large plant at Kobuta, which was built and is being operated for the Government by Koppers United Company.

CARBIDE AND CARBON CHEMICALS CORPORATION also has designed and built for the Defense Plant Corporation, and is operating for the Rubber Reserve Company, another large butadiene plant at Louisville, Ky.

▼

Business men, technicians, teachers, and others are invited to send for the book P-4 "Butadiene and Styrene for Buna S Synthetic Rubber from Grain Alcohol," which explains what these plants do, and what their place is in the Government's rubber program.

BUY WAR BONDS AND STAMPS

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National Carbon Company, Inc.

INDUSTRIAL GASES AND CARBIDE
The Linde Air Products Company
The Oxweld Railroad Service Company
The Prest-O-Lite Company, Inc.

PLASTICS
Bakelite Corporation
Plastics Division of Carbide and Carbon Chemicals Corporation

The material herein has been reviewed and passed by the Office of Rubber Director, the Rubber Reserve Company, the Defense Plant Corporation, and the War Departments.

Silent Sound In Action

(Continued from page 20)

tions during electrolysis, the deposited metal, already in a high state of subdivision, is discharged into the solution in a finely disintegrated form. Similar dispersion may be effected with practically all metals capable of isolation by electrolysis. This method opens the way to scores of improved methods for the manufacture of catalysts and sols for both chemical and pharmaceutical uses. Furthermore, because ultrasonic waves disperse metallic ions during electro-deposition, finished plates may acquire a much finer and more uniform grain size than otherwise obtainable.

While ultrasonic waves have a strongly dispersive effect on emulsions and liquid sols, their effect on liquids and solids suspended in air, or for that matter any gas, is quite the reverse, primarily because of differences in stability. Mist, dust, and smoke coagulate instantaneously under the action of high-frequency sound. Viewing the matter practically, however, the present use of electrostatic air purifiers is considerably more efficient for this purpose.

Liquids and fusions may very readily be degassed by ultrasonics. The expansion of the fluid in the sound wave creates negative pressures in the liquid, causing the emergence of the dissolved gas and the formation of bubbles. This is of particular importance in metallurgical practice, where it is so essential to guarantee that molten metals be freed of a maximum amount of gaseous inclusions.

In soil analysis, it is frequently a heartless task to disperse the colloids absorbed on the surface of the soil particles, demanding sometimes several hours of shaking and centrifugation. Using ultrasonics, in a matter of minutes, the soil sample is completely dispersed and ready for examination.

Molecule Smashing

Ultrasonics may go to work on the molecular level and shatter polymerized compounds. Starch may be broken down into at least six different cleavage products. Gum arabic and gelatine disintegrate. Egg albumin coagulates. Sugars decompose into their constituent monosaccharides. Thixotropic gels, those which may be liquified by agitation, desolidify under the action of ultrasonic rays.

True, trustworthy explanations of all these phenomena are unavailable. Nevertheless, ultrasonics may have considerable influence on the progress of chemical reactions. In many cases, it is a dilemma to isolate the sonic effect from the concurrent thermal effect. It has been shown, however, that ultrasonic waves, of themselves and not as a result of heating, increase the velocities of numerous oxidation and hydrolytic reactions. Distilled water, for instance, may be partially converted to hydrogen peroxide. Potassium permanganate solution is converted to hydrated manganese dioxide. A solution of hydrogen sulfide turns to a milky suspension of free sulfur. It is not improbable that these reactions are promoted by the high concentrations of energy in the solution producing as much as fifteen thousand times the normal hydrostatic pressure. Liquid nitrogen iodide, as an example, explodes when exposed to ultrasonic rays. Of marked practical importance today, ultrasonics is being employed to accelerate the manufacture of plastics. Vast, uncharted possibilities lie before the industrial chemist, particularly in terms of using ultrasonics to increase the kinetics of numberless chemical reactions.

Ultrasonic waves knock the "living daylights" out of small fish,

(Continued on page 24)

The promise of plastics, in the after-war years, holds so much for manufacturers and consumers alike that perhaps we should learn a little more about the nature of these new materials.

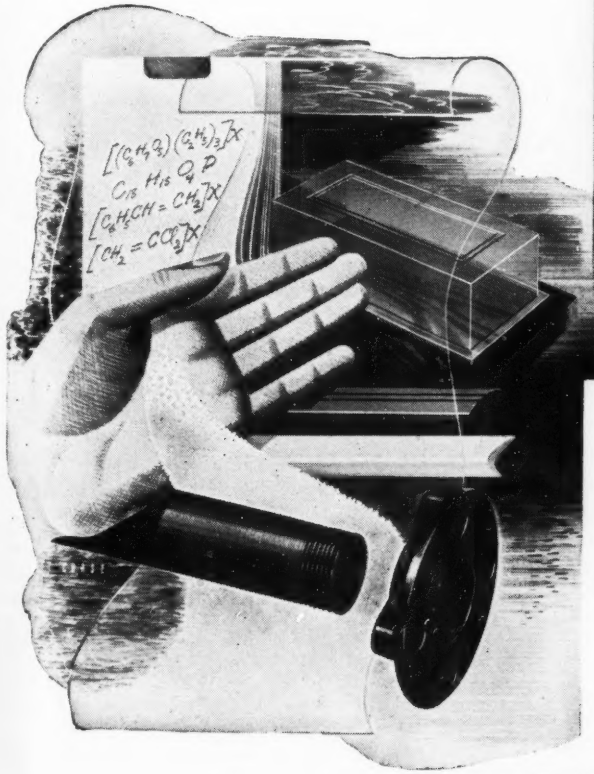
Of prime significance, chemically made plastics are unlike any structural material we have had to work with in the past.

Plastics are the product of chemistry. They are one of the outstanding examples of the chemist's ability to produce—out of coal, petroleum, air, salt, and other basic elements—totally new substances.

Important to an understanding of plastics is that they differ widely in their property characteristics.

For example, some plastics are extremely tough and withstand rough usage. This is true of Ethocel—one of the Dow plastics. Other types are pliable. Some have almost optical qualities in their clarity. Others possess excellent electrical insulating value. Some withstand heat and others extreme cold.

Among Dow plastics possessing some of these properties to a high degree is Styron—a plastic especially valuable as an electrical insulator and having many other uses where lustrous beauty or resistance to acids and alkalis are factors of importance. Saran, on the other hand, is notable for its tensile strength and flexibility, which make it widely used for such products as tubing, woven fabrics and rope. Ethocel, in a special formula, is especially strong and tough at extremely low temperatures.



JUST WHAT ARE "PLASTICS"?

The important point to remember is that the science of plastics is progressing rapidly. Already there exist many specialized plastics for specific applications. As our knowledge of both plastic compositions and the techniques for handling them increases, these new materials will undoubtedly become even more widely used than is now planned.

Dow Plastics include
Styron, Saran, Saran Film, Ethocel and Ethocel Sheeting

DOW PLASTICS

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

New York Boston Philadelphia Washington Cleveland Detroit Chicago St. Louis Houston San Francisco Los Angeles Seattle

Silent Sound In Action

(Continued from page 22)

frogs, and protozoa. Mice are paralyzed by a twenty-minute exposure. Algae and red blood corpuscles are torn to bits. The reproductive power of yeast cells and the luminosity of luminous bacteria are utterly destroyed. In a commercially useful fashion, milk may be sterilized by radiating it with supersonic waves. Because of the very limited rise in temperature brought about by the exposure, the bacteria are killed without altering the taste of the milk, a problem normally associated with pasteurization. To be sure, suitable bacteria must be subsequently added in required amounts, since the consumer depends largely on milk for providing the bacteria necessary for immunization. In addition, ultrasonics has been used to homogenize milk so that there is no separation of the cream. Ultrasonic waves may also be employed to curd milk sufficiently to make it more easily digestible by infants and special dietary cases.

Because intense ultrasonics may produce appreciable elevations in temperature, its medical use in diathermy has been proposed. The marrow of the bone may be heated without simultaneously affecting the bone or the skin tissue. Here lies a whole new field for utilizing ultrasonic therapy as a supplement to the current application of electrical diathermy.

Of further medical importance, sonic vibrations are put to work disintegrating sulfa drugs. Sulfathiozole crystals, for instance, are reduced to microscopic particles which, when suspended in water, give a preparation with the consistency of thick cream. Injected through hypodermic needles, usually impossible with ordinary suspensions of sulfa drugs because of the large and irregular size of the crystals, this material offers improved uses in many fields of medicine, including successful application to wounds and infections and during abdominal operations. Because of their increased surface area, these sulfathiozole microcrystals much more readily halt germ invasion, lumping and caking of the drug being eliminated.

Ultrasonic vibrations make possible the extraction of anti-bodies secreted in the cells of pathogenic bacteria. Formerly, this procedure was crudely undertaken with a ball mill, which gave unsatisfactory results. Ultrasonically the cells are torn apart, releasing the desired anti-bodies. After the solid debris of bacterial cell walls is removed by centrifugation, the residual liquid is collected for use in immunization, especially in work against typhoid.

Cancer Treatment

Recently it has been found that ultrasonics suspends abdominal cancer in rats. Scientists hope to discover a differential effect of these sound waves on cancerous and normal human tissue. This newly devised method suggests a treatment which may some day rank with x-rays and gamma rays in cancer therapy.

Today it is difficult or impossible to follow the growth of ultrasonics in the promotion of human welfare. The field is vast. The potentialities are far beyond the compass of present estimation. Ultrasonics is to sound what ultra-high-frequency technique is to radio. Both have indefinitely expansible futures.

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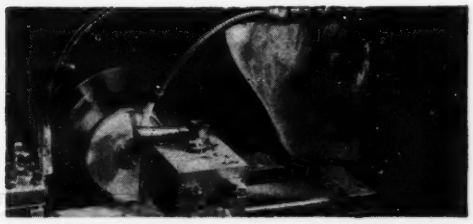

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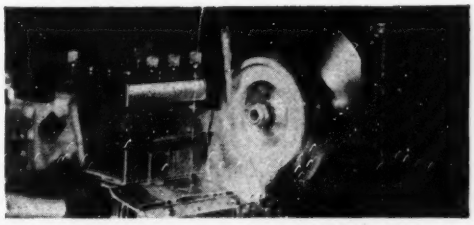

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For Cutting STEEL

TUNGSTEN CARBIDES ★ ★ ★ TUNGSTEN CARBIDES WITH TANTALUM AND/OR TITANIUM CARBIDES

Engineering in Syria

(Continued from page 9)

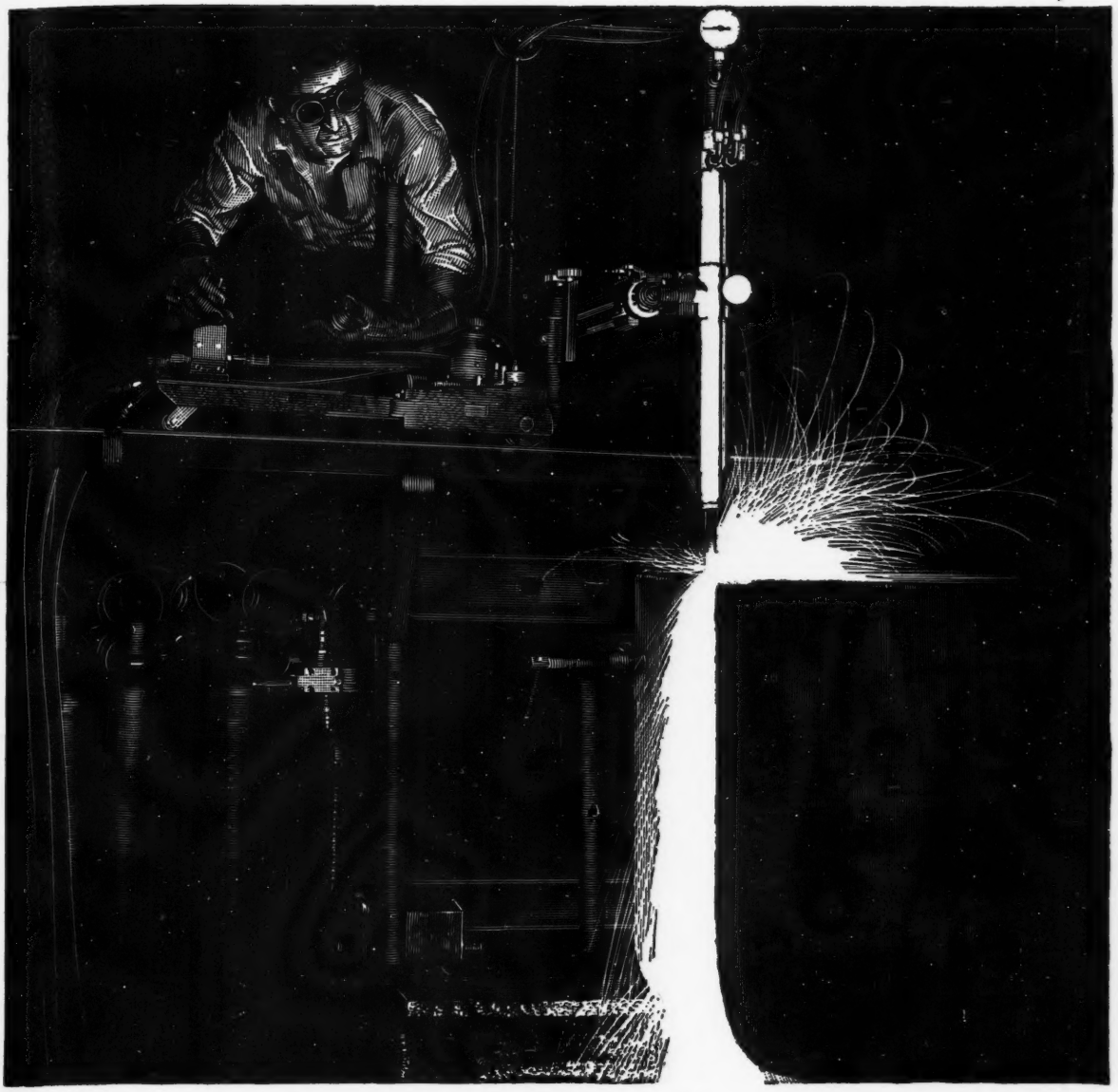
signs, except in the homes of the rich, who prefer the use of imported marble.

It is not unusual to find huge structures in the country. However, high buildings of the sky-scraper type are out of the question. The purchase prices of land are so low that economy warrants spreading of the structure rather than piling it high. The general practice is to limit all buildings to seven or eight stories. Within the city limits of Beirut, where land is comparatively expensive, the city building code limits the height of structures to twelve stories with a 45° roof, but in no case can a building be more than 200 ft. high. This item of the code is a result of an extensive study of the type of foundation soil which is generally encountered in the city. Driving piles would improve the bearing capacity of the subsoil a great deal, but, here again, economy justifies spreading of the structure. In the outskirts of the city, where more favorable foundation conditions are encountered, the prices of land are such that high structures constitute false economy.

Social Standing

Socially, the engineer in Syria ranks high. Among professional men he is looked upon as second to none, and in all kinds of societies he is treated with the utmost respect. Doctors are the only competitors with engineers in social standing. Some societies classify doctors next to the engineer and others vice versa. Otherwise, no professional man approaches to the social position which the engineer occupies. This may seem to be a broad statement but nevertheless it is very true, and its validity has been proven time and again.

The Government Bureau of Construction has contributed much in promoting the standard of the engineer. Years ago, it passed a resolution stating that no construction, regardless of size or place, can be erected or remodeled without a set of plans prepared by a certified engineer and approved by this office. This act opened the eyes of the public toward the engineering profession and was the first stepping stone for the important role, socially and professionally, which the engineer plays in Syria.



Cutting 1000 Hours Off an Ordnance Schedule

Under the piercing heat of the oxy-acetylene cutting flame, thick metals like this 32" alloy steel block are shaped into parts for heavy weapons faster than ever before.

For example, the flame cutting operation shown here saves more than 1000 hours machining time in producing one heavy part for ordnance use. Similar valuable savings in time and labor are being achieved on hundreds of other war production schedules by this method . . . cutting steel up to 51" thick on a fast, production basis.

Air Reduction engineers have pioneered in the development of many machine flame-cutting methods to speed operations in war and peacetime industry.

If you would like to receive our informative publication "Airco in the News," we shall be glad to send a free copy. Write to Mr. G. Van Alstyne, Dept. C. P., Air Reduction, 60 East 42nd Street, New York 17, N. Y.

★ BUY UNITED STATES WAR BONDS ★

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MAGNOLIA AIRCO GAS PRODUCTS CO.
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OXYGEN, ACETYLENE AND OTHER ATMOSPHERIC GASES • GAS WELDING AND CUTTING APPARATUS • CALCIUM CARBIDE ARC WELDING MACHINES AND SUPPLIES • CARBON DIOXIDE • "DRY ICE" • ANAESTHETIC AND THERAPEUTIC GASES AND APPARATUS

Miss Lucy Broadhead

(Continued from page 13)

full arrangements for job interviews between employers and prospective chemical engineering graduates.

In off-hours, you will find Lucy on the top floor of Franklin Hall, whamming a niblick or putter while taking golf lessons. During vacations—which are few and far between these days—Lucy takes time off for swimming and sailing in Skaneateles Lake, New York. Or if you're in Olin Hall at about four in the afternoon on weekdays, you'll discover Lucy and the Chem E. staff congregating in the tiny kitchenette near the main office for a few minutes of relaxation over coffee and cookies. Or if you have the spare time some afternoon after four-thirty, drop into the Chem E. office. You'll find Lucy finishing last-minute jobs before closing up shop. If it's a Tuesday, from a disance, you'll hear the muffled voices of the Chemical Engineering chorus, harmonizing on several of the old favorites and some new ones besides, to piano accompaniment in the adjacent conference room. Lights out. Papers away. Miss Lucy Broadhead completes another day's valuable contribution to work in the School of Chemical Engineering.

Miss Lillian Lehmann

All Mechanical Engineering students have probably had to do business with Miss Lillian Lehmann, secretary of the Director, Professor William Barnard. She is partial to her job and likes the variety it offers, but she shies away from publicity. In spite of this, she divulged some of her past, but very reluctantly.

Miss Lehmann was born not so long ago in Batavia, New York. After a few carefree high school days, Miss Lehmann came to Cornell. She was an English major in the Arts College and never thought she would ever have anything to do with Cornell engineers. Following graduation in 1928, Miss Lehmann went to Stamford, Connecticut, to teach high school English. From there, she went to Troy to study secretarial work at R.P.I. Having a deep love for her alma mater, Lillian came back to Cornell to do statistical work in Agricultural Economics. From there, she transferred to the M.E. office and has been there since May of 1941. She seems to be here to stay, since it is her most interesting and best-liked job so far.

This year, Miss Lehmann is very busy doing war jobs on the campus. Those boys who go to the Barnes Service Center know that she is Assistant Head Hostess. She also does surgical dressings for the Red Cross. Lillian remembers well the days when she used to have time for light recreation. She likes to swim, skate, play bridge, and dance. Miss Lehmann makes her home in a small apartment on State Street in Ithaca. But it is advisable to make your dates in her office in Sibley.

As to why we have no picture of Miss Lehmann, she is quoted as having told the staff photographer, "I would rather you took a picture of me lying on the beach in the summer." Perhaps next summer we can print a picture of Miss Lehmann in a scanty bathing suit. In the meantime, she is happy over the coming of spring and can't wait to go swimming in Cayuga Lake.

Your Tomorrow Began Yesterday

Yesterday someone did something that will make tomorrow better.

We do not mean to be Pollyanna. We are totally engaged in the grim business of producing for war. But it is still hard, realistic fact that the good things of tomorrow are being planned today, were planned yesterday. Jobs, for instance. Your future job.

This is one reason why we enjoy working with aluminum. It's full of possibilities for making new things, and making old things better. The future of aluminum is exciting.

There is now much more aluminum and it costs less. It will be usable in many more places. Alcoa has been imagineering in aluminum for 54 years and we have good reason to feel the postwar future of aluminum is something for a man to want to have a part of.

Look what aluminum can do to help patch up this shattered old world. It's the wings of the Air Age. It is going to tie remote peoples together and help bring about understanding.

Aluminum's strength with light weight makes things easier to lift, less expensive to move. It offers another spurt of growth to all forms of transportation.

Alcoa Alloys in brilliant colors promise a new splurge for beauty. Think what you can do to brighten homes and hospitals, stores and schools with a metal that is easy to work, resistant to corrosion, light, strong and capable of being dyed practically any color of the rainbow!

We have seen a lot of good imagination engineered into plans utilizing Alcoa Alloys. We have done some Imagineering of our own, too.

These plans are today's blue-prints for tomorrow's jobs. Many of you younger men will be needed to turn them into action. In fact, we hope some of you will want to help put across the ideas we have been cooking up here at Alcoa.

A PARENTHETICAL ASIDE: FROM THE AUTOBIOGRAPHY OF

ALCOA ALUMINUM

• This message is printed by Aluminum Company of America to help people to understand *what we do* and *what sort of men* make aluminum grow in usefulness.

Dr. Durand

(Continued from page 7)

study or committee report in which he is involved, there is seldom, if ever, a dissenting opinion.

"None of us can of course know what he himself thinks of these things or even whether he thinks at all of a way of life which seems to him so perfectly natural. Be that as it may, it is hard to conceive of a more satisfying capstone to a career of service for a man than one which on this eighty-fifth birthday is found to be compounded of the respect, admiration, esteem and above all, the love of his associates."

If a few additional words of appreciation may be considered appropriate, I may state that it was my good fortune to assist Dr. Durand in some of his work from 1908 to 1911, when I left Stanford to come to Cornell. At that time, he was engaged in some of the preliminary work pertaining to the Boulder Dam project that was not completed until about twenty-five years later. This work often involved many days of strenuous travel and crude accommodations, but regardless of how tired he might be upon his return to his office, he was always cheerful, patient, and good natured. His ability to make calculations and draft excellent preliminary reports while traveling is another characteristic that has helped to make him such an outstanding engineer.

In 1891 Dr. Durand came to Cornell and established the Graduate school of Marine Construction. While here he did much valuable research work on ship resistance and propellers. For some of this work he used the old steamer Horton on Cayuga Lake*; and for the remainder, he used the experimental canal that has been curiously observed in recent years by many Cornellians as they have strolled by the south end of the dam at Beebe Lake. This 340 foot canal and its equipment as used by Dr. Durand are described by him in an article in the Sibley Journal of Engineering for January 1902. The results of this research work were largely incorporated in his famous book "Resistance and Propulsion of Ships" published in 1898. This classical book was the first one to use non-dimensional parameters to show the correlation between data obtained from tests of actual ships and models.

Acting Director

After Dr. Thurston's death in 1903, Dr. Durand was Acting Director of Sibley College until he resigned in 1904 to become head of the Department of Mechanical Engineering at Stanford University where he became greatly beloved and where he still maintains a fine residence, although he has not had the opportunity to enjoy it much after his "academic retirement" twenty years ago. As the years go by there seems to be an increase, rather than a decrease, in the demands for his valuable services in various activities.

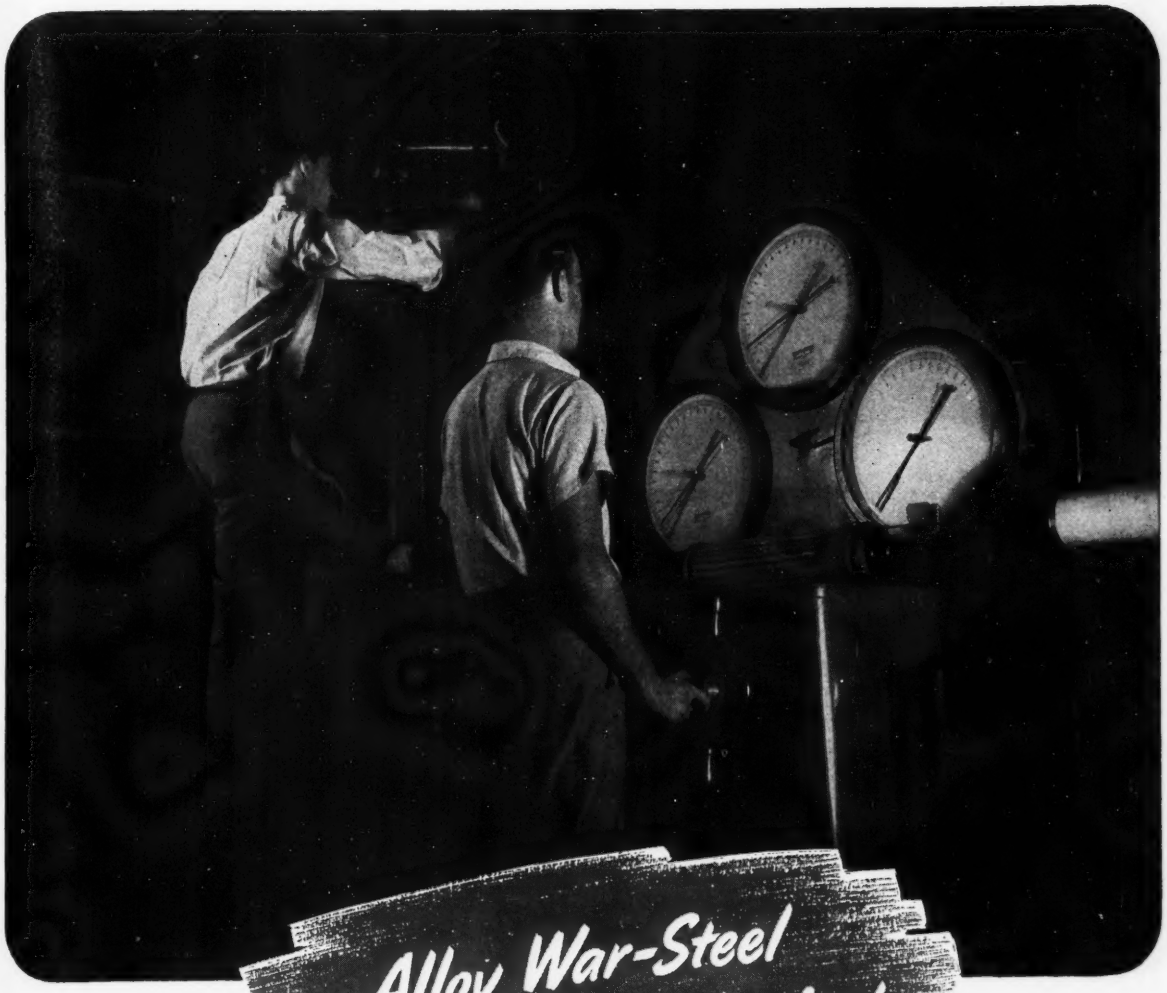
At the time of his departure from Cornell, the Sibley Journal of Engineering, October 1904, stated that he was "a thorough scholar, an enthusiastic investigator, a sympathetic and remarkably able teacher." Every one who knows Dr. Durand can readily appreciate the accuracy of this statement.

Dr. Durand's work has covered such an extremely wide field that a dozen men from many diversified fields were called upon at this anniversary dinner to mention briefly some of his accomplishments after he graduated from the United States Naval Academy at the age of twenty-one. Even at eight-five, Dr. Durand's response showed his usual vigor and clarity of expression as he related many interesting experiences that pertained to "the important decisions that affected his life." In this talk, he also told briefly some of the interesting facts pertaining to the exciting and important trials of the U.S.S. Dolphin, which was one of our first steel vessels; and I hope the editor of this magazine may induce Dr. Durand to write the complete story for publication, since it is of great historical interest and full of thrills for the layman as well as the engineer.

The CORNELL ENGINEER may justly be proud of the fact that the first selected paper appearing in the Durand Anniversary Volume is the "Life History of an Ocean Wave", taken from the Sibley Journal of Engineering, April, 1896. This article is one that I can heartily recommend as an interesting and valuable one that may well be enjoyed by all the young men on our campus today.

I consider it a great honor to have had the opportunity to attend this dinner and to have been called upon to describe briefly some of Dr. Durand's work at Cornell. I feel sure that his many Cornell friends will be pleased to know that he is still actively engaged in important war work in Washington, and that he is vigorous and alert in both mind and body. May he so continue for many years yet to come!

*See Proceedings Society of Naval Architects and Marine Engineers, Vol. V, p. 107.



Alloy War-Steel reports for its physical

OWI Photo by Palmer, in an Allegheny Ludlum Plant

TESTING is an integral part of steel production at Allegheny Ludlum mills, because one of the "must" requirements for an alloy steel today is that it possesses—to the full—every one of the special properties desired by the user.

To help prevent failure of a part during operation, amazingly accurate machinery, worth thousands of dollars, is on the job at each Allegheny Ludlum mill, testing each lot of steel before it is shipped out to become fighting parts of planes, tanks, guns, ships or munitions. These steels *must* be right, for in the urgency of battles tremendous stresses are put upon the key parts for which alloy steels are chosen—and those parts must not fail when men's lives are at stake.

It is under such war conditions that Allegheny Ludlum steels have proved their worth. Right now they're helping to uphold the traditions of a free America, so that all of us may retain them in the future. When peace is restored, Allegheny Metal and other alloy steels will take their rightful place again in the enrichment of the post-war world.

But now—today—these metals are supporting the attack. Be sure you are also supporting our fighters, from your place behind the lines. Buy war bonds regularly! Top that ten per cent . . . buy them to the limit of your ability.

Allegheny Ludlum
STEEL CORPORATION
BRACKENRIDGE, PENNSYLVANIA

W & D A-9314

Six-way Microphone

(Continued from page 6)

and may be moved up and down or from one end of the arena to the other for different performances. A typical set-up has been with the microphone position at one side of the arena. The improvement was 6 db over the cardioid pattern which in turn was 6 db over that of the moving-coil setting of the switch. There was also an improvement in naturalness because the microphone gave more prominence to direct over reverberant sound. The different pick-up patterns of the 639B microphone make it unusually well adapted to the changing requirements of the Garden program.

These public-address demonstrations suggested that reverberation effects in studio pick-up might be controlled to a greater degree than heretofore. This was corroborated in practice, through the cooperation of WOR, with a mall symphonic orchestra. A curious subjective effect noted in these trials was that the bass, cleared of excess low-frequency reverberation, permitted the ear to give more attention to other sounds, thus aiding the impression of definition among all the instruments.

At times, an illusion of sounds different from those observed at the microphone is wanted and elaborate synthetic reverberation machines have been constructed to create these effects. Additional reverberation may be used to give an impression of space and distance and the 639B microphone may be employed for this purpose where studio characteristics permit. Direct sounds can be eliminated entirely from the pick-up by properly directing the microphone and selecting the desired zone of minimum sensitivity. This extreme may be modified by actually using the microphone backwards; that is, by pointing the smaller lobe toward the source of sound. Thus, the various pick-up patterns in the 639B microphone allow reverberation effects to be enhanced or suppressed at will. This new control may be useful in studios which are operated under crowded conditions.

There is no simple way of expressing completely and quantitatively the value of a given directivity pattern. Choice of the pattern best suited to a particular acoustical condition is best made by trial. This is easily accomplished with the new microphone by turning the switch to the several patterns in succession.

Publications

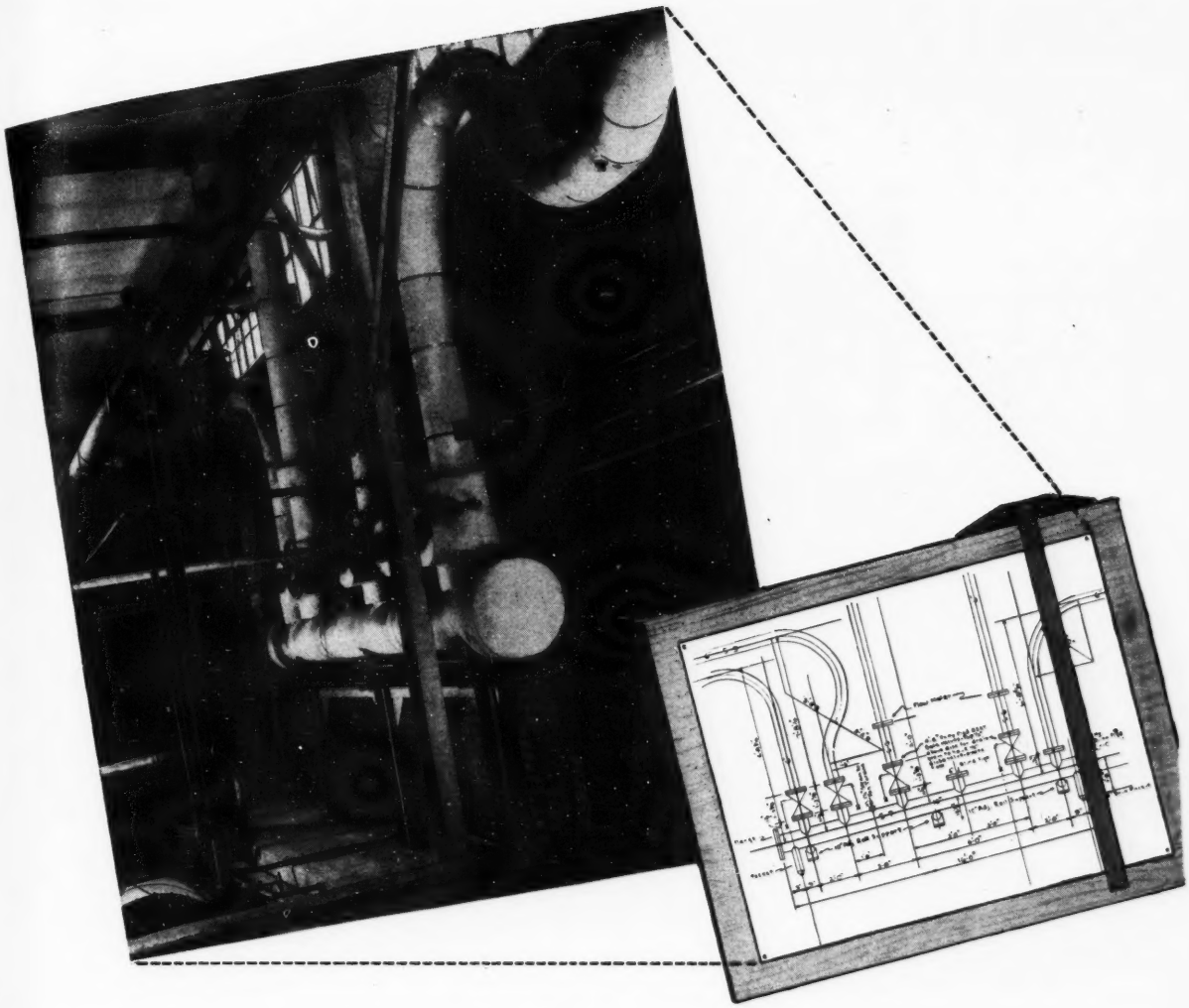
(Continued from page 16)

girder is given. Illustrations showing recommended details for welded construction and many useful design charts are appended.

Chapter twelve explains the general principles involved in the design of column bases and steel-grillage footings. Typical designs of a single-column footing and a double-column footing are included.

The real value of this book lies in the fact that so many essential topics are assembled for ready reference in one small volume. These topics are discussed as completely as possible in the limited space available. The discussions are clear and logical. A careful study of the book should make it possible for the thinking student to apply the given

(Continued on page 34)



PIPING *is more than a line on a blueprint...*

TRANSLATING a piping blueprint into terms of pipe sizes—kinds of fittings—types of valves will have much to do with determining whether an engineering project is a success or a failure. For almost any project is inconceivable without piping, which controls the flow of air, gas, steam, water, oil or other liquids.

You are probably familiar with the high quality—the precise manufacture—that characterizes valves and fittings made by Crane. You may not know that the Crane line includes equipment for *every need* of *every piping system everywhere.*

Writing "Crane" on a complete piping specification has many advantages to the engineer. First: He knows that every item in the system will come from one source, saving valuable time all down the line from drafting room to final assembly. Second: The project will have a matched piping system—with all parts designed to work together. But, above all, he is assured of the long life and satisfactory operation that come from the exact design and high quality that are a part of every piping item carrying the name Crane.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.

CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

Publications

(Continued from page 32)

principles to all except the most unusual problems, in the analysis of which judgment and experience are factors obviously as important as a knowledge of fundamental theory.

C. E. O'Rourke
Professor of Structural Engineering

Railroad Club

(Continued from page 14)

controversial question of the steam engine vs. the diesel engine vs. the electric engine for railroad power. Movies on all three types were shown, and Professor Barnes spoke on their relative advantages. Another meeting to be held soon will have "Signalling" as its topic for discussion.

The membership of the rejuvenated club is made up of a rather varied group. Some are factulty members ,others are Ithacans interested in railroads, and still others are students. Although the practices of the old railroad club of taking excursions to observe railroads in action must be abandoned, the present club hopes to substitue instructive meetings with a large number of movies in place of this "laboratory" work.

ASCE

THE ASCE held a meeting on Friday, March 17, in Sibley Hall. Howard Whitman '22, gave a talk on Regional Power Development of the Lower Susquehenna. Assistant Professor John Perry has succeeded Professor Barnes as Advisor for the society.

Delta Club

NEW officers were elected and initiates were chosen at a meeting of the Delta Club on the 17th of March. Nicholas Markason was elected president and H. C. Whitman was re-elected secretary-treasurer. The electrical engineering club is planning for an active term. The new pledges, who will be initiated on Saturday afternoon, April 8th, are: A. E. Smith, L. A. Weber V-12, P. Cushing V-12, B. E. Nichols V-12, W. T. Duboc V-12, A. L. Yehle V-12, L. H. Bogen, D. R. Craig V-12, M. Holland V-12, and W. E. Burnett V-12.

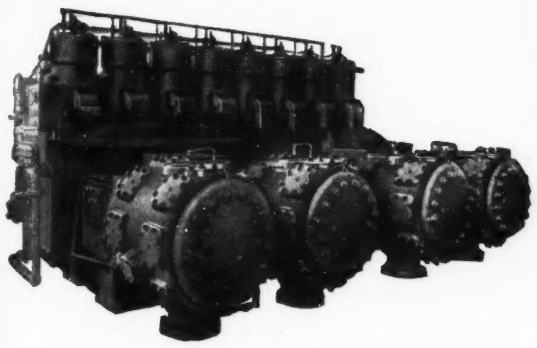
Civil Engineers Elect

ELECTIONS were held Friday, March 17th, for the president and secretary of each class in the School of Civil Engineering. Those who were elected are as follows:

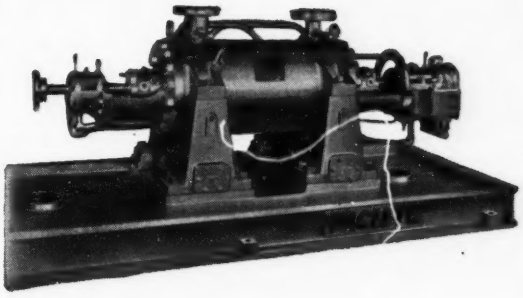
7th & 8th terms
Pres., C. K. Kerby
Secy., D. E. Carter
5th & 6th terms
Pres., Eddie Lannom
Secy., Park Metzger
3rd & 4th terms
Pres., J. G. Gnaedinger
Secy., M. L. Steinberg
1st & 2nd terms
Pres., Ed Young
Secy., Jeanne Mount

Besides serving in their capacity as heads of their respective class groups, those elected will make up the committee whose duty it is to take disciplinary action in cases of infraction of the student Honor Code. The committee plans to impress upon the C.E. student body the obligations as well as the advantages of the Honor System.

At a meeting of the committee Friday, March 24, C. K. Kerby was chosen chairman, and Eddie Lannom, secretary.



CLARK 8 Cyl. 800 B. H. P.
GAS ENGINE DRIVEN COMPRESSOR



Pacific Type ITB—Hot Oil, Multi-Stage Horizontal, Forged Steel Shell, Double-Case, High Pressure Centrifugal Pump.

Achievements in the Field

Half of Clark Bros. 64-year history has been largely devoted to developing and perfecting the "2 Cycle" Engine. Clark engineers, with far-sighted vision, recognized "2 Cycle" as the ultimate engine as long ago as 1910. Years of successful experiment and research produced the modern Clark "2 Cycle."

No greater tribute could be paid Clark for the hard pioneering years, than the wide acceptance Clark "2 Cycle" enjoys today, not only throughout the Petroleum Industry, but in many of the world's largest war industries such as Synthetic Rubber, Synthetic Ammonia and Toluene plants.

Illustrated above is the Clark 8 cylinder—800 B. H. P.—"2 Cycle" Gas Engine Driven Compressor. Because of its notable records in outstanding Recycling and Pressure Maintenance plant, petroleum engineers consider it "standard equipment."

Twenty years ago Pacific Engineers, in a modest little pump shop, startled the world with a radically new oil pumping technique. In those days oil pumps were costly and unreliable. They either ground themselves to uselessness in a few months or corrosion did the trick.

So these alert Pacific engineers took the micrometer, new alloys, finest of materials and developed new engineering methods. They created a group of precision pumps that defied all oil field and refinery pumping conditions—pumps of efficiency and economy with a life measured in years instead of months.

Today—in a large modern plant—Pacific still maintains its leadership with a complete line of centrifugal, turbine and plunger types of precision pumps for water well, oil well, refinery, pipeline, process, boiler feed and hot oil operations, as well as large emulsion pumps for synthetic rubber plants.

CLARK BROS. CO., INC.
Olean, N. Y.

PACIFIC PUMPWORKS
5715 Bickett St., Huntington Pk., Cal.

"Two of the Dresser Industries"

STRESS and STRAIN...

Mandy Johnson, surrounded by her brood of 11 or 12 pickaninnies was talking to the old maid settlement worker. "Yas'm," she said, "birth control am all right for you all, but me, Ah's married an' don' need it."

* * *

Both girls riding in the car were injured when it overturned. Miss ——— was cut about the face and hands, and Miss———in the back seat.

* * *

"Honestly, girlie, I'm afraid of my own shadow."

"G'wan, you can't kid me. These lights stay on."

* * *

Miriam had not been doing very well in history, although her marks were high in every other course. One day she was called into the professor's office for a conference.

"I'd do anything if I could pass, professor, anything at all."

"Anything?"

"Yes, anything."

"Are you sure?"

"I just have to pass, professor. Yes, I'd do anything."

"Hmmm, what are you doing Friday night, Miriam?"

"Why, nothing at all, professor."

"Well, Miriam, I think you might do a little studying."

* * *

A middle aged woman lost her balance and fell out of a window into a garbage can. Chinese passing remarked: "Amelicans velly wasteful. That woman good for ten years yet."

* * *

An optimist is a man who thinks his wife has stopped smoking cigarettes when he finds cigar ashes around the house.

* * *

While practicing for the ROTC review last term, one of the cadet commanders was seized with a bad case of stuttering. Seeing his platoon half out of Barton Hall, and heading in the general direction of Lake Cayuga, the lieutenant pleaded, "Say something, if only goodbye."

Curious Old Lady: "Why, you've lost your leg, haven't you?"

Cripple: "Well darned if I haven't."

* * *

WANT AD: Wanted — Stenographer for heating contractor's office.

* * *

CHURCH BULLETIN: The ladies of the church have cast off clothing of all kinds. They may be seen in the basement of the church any afternoon this week.

* * *

We are pleased to note the recent resurrection of the still defunct (as is shown by its latest issue) Cornell Widow. At last Cornellians can get their monthly digest of all the off color jokes in the **Harvard Lampoon, Columbia Jester,** and **Cornell Engineer.**

* * *

We believe it would be a good idea, just to keep up the balance of power, for the *bulletin* to retire to that oblivion from which the *Widow*, like the proverbial wolf on the fold, has recently descended. The only part of the bulletin anyone ever reads anyway, is the list of social events, and we could print that for the month, as there aren't many Arts school men left to miss it.

* * *

It has been wondered what the civilian man will do after the war when he has no air raid warden or other civilian defense work to perform . . . Most likely he'll dig up some of his old excuses.

* * *

Physics Prof.: "You can't sleep in my class."

V-12: "If you didn't talk so loud, I could."

* * *

Our heating engineers suggest, in this time of national emergency, cellophane clothing to keep each other warm.

* * *

An AE is someone who concentrates more and more on less and less. till he knows everything about nothing.

Two Home Ec majors overheard in the Dutch:

"So you broke your engagement to that Arts student, didja, Mamie?"

"Yeah, he had no tact. He sat around talkin' about Atlantis and Catherine II and Themistocles, and he knows I don't like horse racin'."

* * *

Customer: "I'd like a dollar dinner, please."

Waiter: "On white or rye, sir?"

* * *

And then there was the freshman engineer who thought that a slide rule was a regulation pertaining to baseball.

* * *

"Lips that touch wine shall never touch mine," said the co-ed in engineering, and after she graduated she taught school for years and years and years and years.

* * *

Definitions:

Architect: One who drafts a plan of your house and plans a draft of your money.

Excess: In morals, an indulgence that enforces by appropriate penalties the law of moderation.

Gallows: A stage for the performance of miracle plays in which the leading character is translated to heaven. It is chiefly remarkable in this country for the number of people who escape it.

Advice: The smallest common coin.

Politeness: The most acceptable hypocrisy.

* * *

"There's only one thing wrong with me, blondie. I'm color-blind."

"Yo' sho' mus' be, mistah."

* * *

"And how is your good wife, Sultan?"

"Oh, she's all right, but the other forty-nine are more fun."